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Leveraging easy to use ML, NLP and interactive 3D visualization to uncover key insights

VIRTUALITICS®

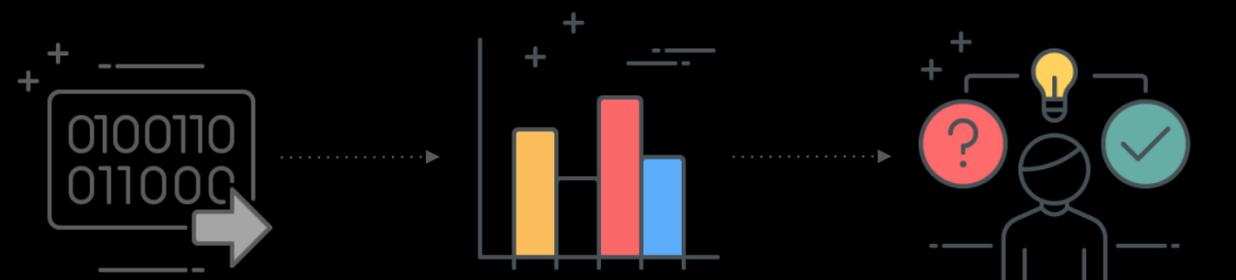
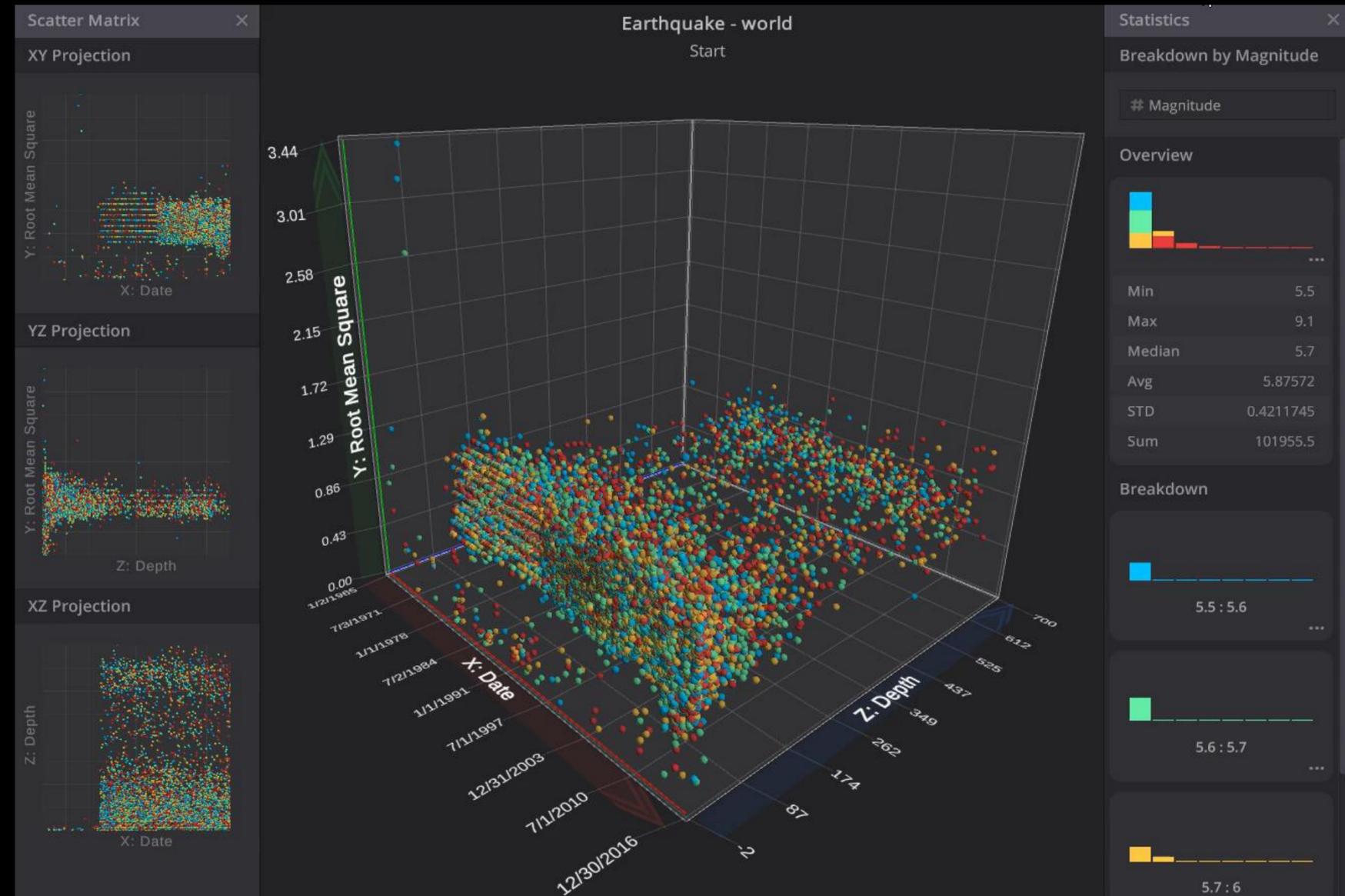
Based on 10+ years of research at Caltech & JPL

Who are we?

AI company with focus on Explainability (XAI).

Advanced data analytics and visualization platform for exploration and collaboration in either desktop or virtual reality.

Embedded easy-to-use ML routines for insights extraction and explainability.



Raw Data

**Virtualitics
Platform**

Smarter data-driven
decisions

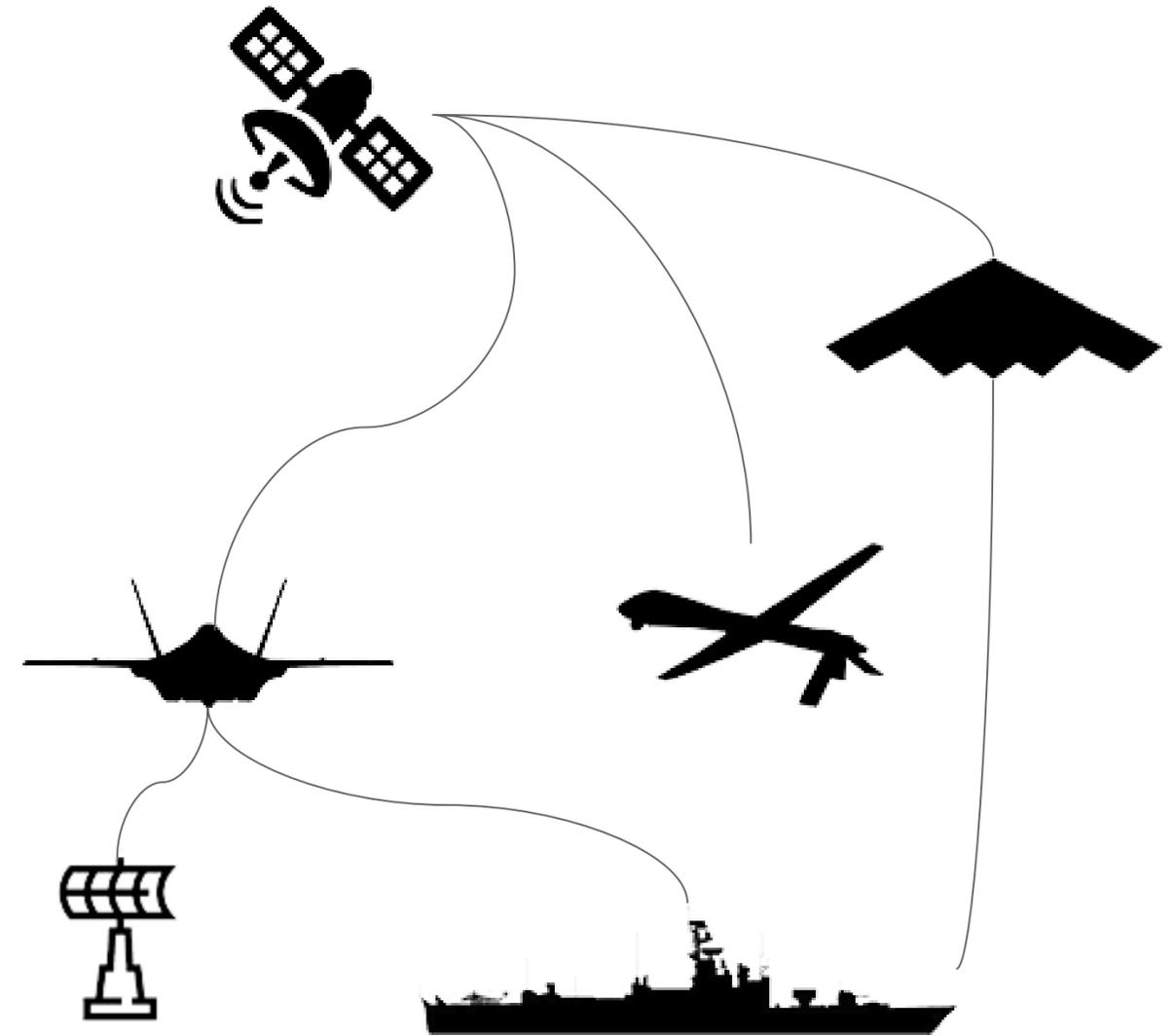
Free trial: <https://www.virtualitics.com>

Widespread traction in Federal and Private sectors



Image credit: Forbes.com

Advanced data exploration
AI explainability
Predictive analytics
Real-time collaboration



VIRTUALITICS®

Air Force Strategic Award

Virtualitics selected as one of 21 “Big Bets” in tech by Air Force

“21 ‘big bet’ companies are slated to receive four-year, fixed-price contracts... [Assistant Secretary] Roper said he believes future rounds of funding will be bigger.”



The image is a screenshot of a news article from the U.S. Air Force website. The header features the U.S. Air Force logo and the text "U.S. AIR FORCE". Below the header, the breadcrumb navigation reads "HOME > NEWS > ARTICLE DISPLAY". The main headline is "Air Force pivots to virtually connect defense innovators, announces 'big bets'", and the sub-headline is "AFWERX Public Affairs / Published March 13, 2020". The article image shows three people in a modern, brightly lit room. Two people are seated on a blue sofa, and one person in a military uniform is seated in a white chair, gesturing towards a large screen displaying "PITCH BOWL".

Source: <https://www.af.mil/News/Article-Display/Article/2111607/air-force-pivots-to-virtually-connect-defense-innovators-announces-big-bets/>



Multiple sources - people or machines - generate **large amounts** of data very **quickly**



and the data is **gathered** and **analysed**



to gain new **insights**

How can big data improve our lives?

Environment

New solutions for climate change mitigation

Healthcare

Better diagnosis and more successful treatments

Industry

Innovative products, improved productivity, economic growth



Agriculture

Improved food safety and use of natural resources

Public sector

Increased efficiency and transparency

Transportation

Regulating traffic flows, preventing traffic jams

WE'VE DECIDED
TO TAKE BIG
DATA TO THE
NEXT LEVEL...



**HUMONGOUS
DATA**

Image credit: David Fletcher

Autonomous vehicles: 4000GB per day.

Smart Factories: several PB of data per day.

IoT devices: 80ZB of data by 2025 (was 14ZB in 2019).

Are companies equipped to deal with these new data challenges?

Goals

**Extract actionable insights and make
better and faster data driven
decisions**

Goals

**Extract actionable insights and make
better and faster data driven
decisions**

and

**Explain results from complex AI
models to non-technical decision
makers**

Why Explainable AI?

AI adoption is difficult if humans cannot understand its output

AI surpasses human understanding: Results may be difficult or impossible to explain.

Still... we rely on AI also for making life or death decisions.

Increasing the trust: growing need for communicating AI insights in an effective way.

Why did the AI make this prediction?
Why not something else?
When did the AI system succeed?
When did the AI fail?
How can I trust it?
How can I correct errors that arise?



Consequential AI

Life and death situations

Purpose: Aid to humans or fully autonomous decisions?

No room for errors: autonomous vehicles, medical diagnosis, military drones, etc.

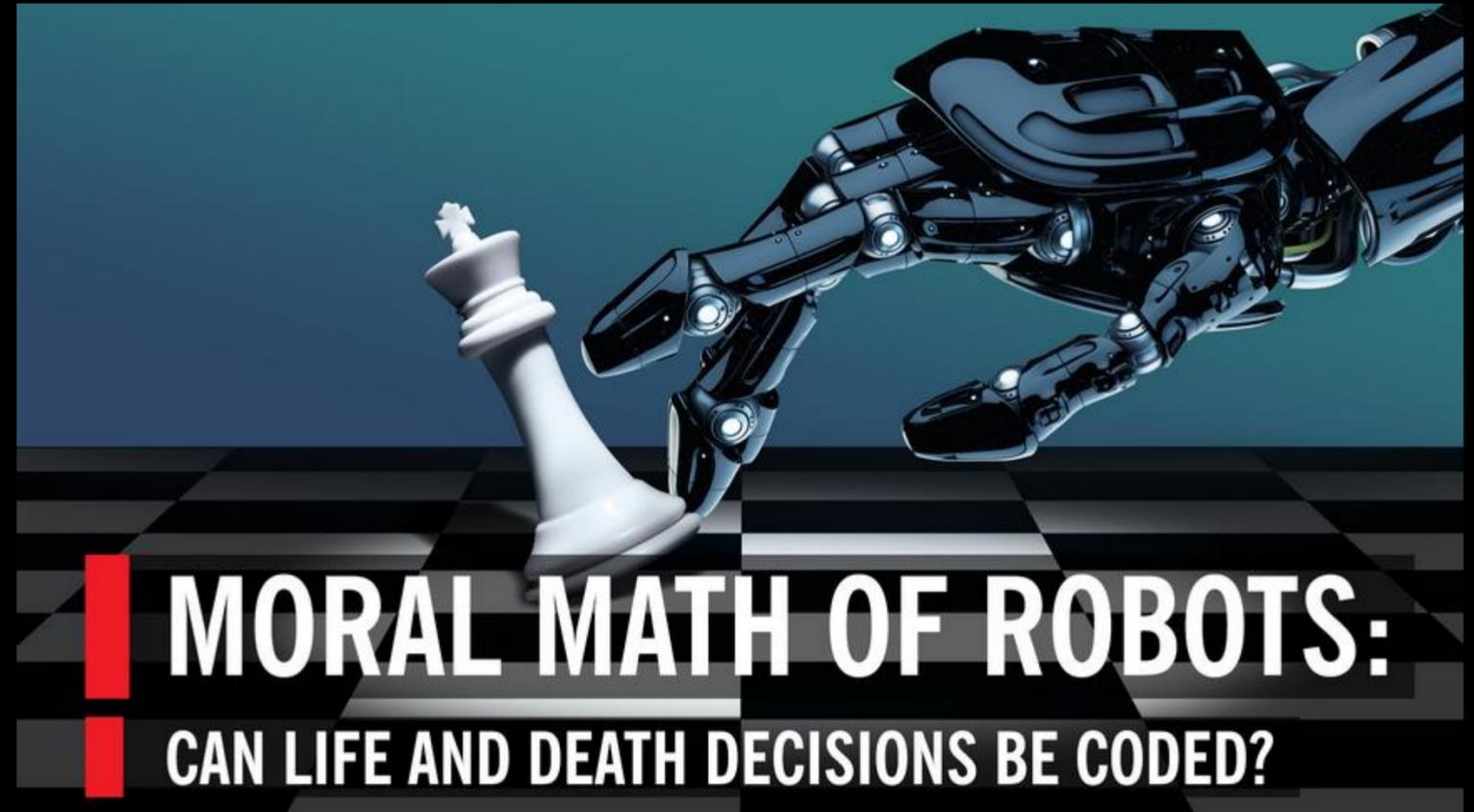


Image credit: Worldsciencefestival.com

Gartner Report, October 2020

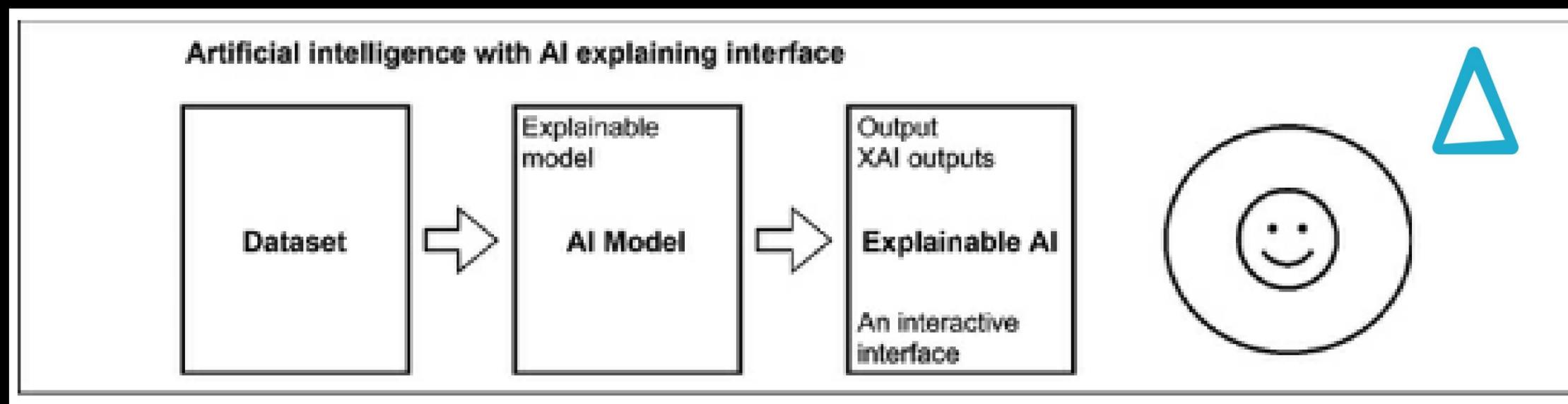
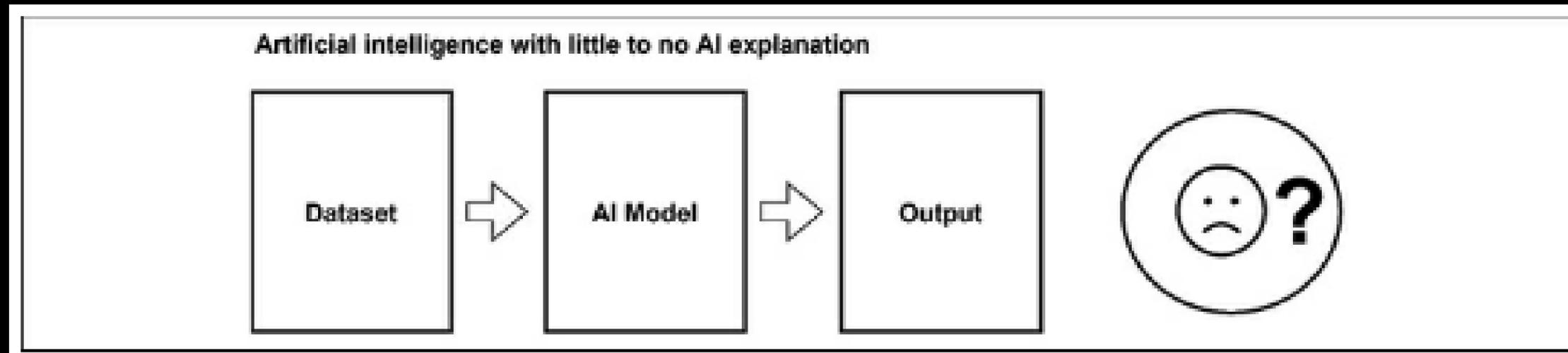
Trend 1: Smarter, faster, more responsible AI

*"Responsible AI that enables **model transparency** is essential to protect against poor decisions. It results in better human-machine collaboration and **trust for greater adoption** and alignment of decisions throughout the organization."*

Gartner Top 10 Trends in Data and Analytics for 2020

Data & Analytics

📺 Live from #GartnerSYM



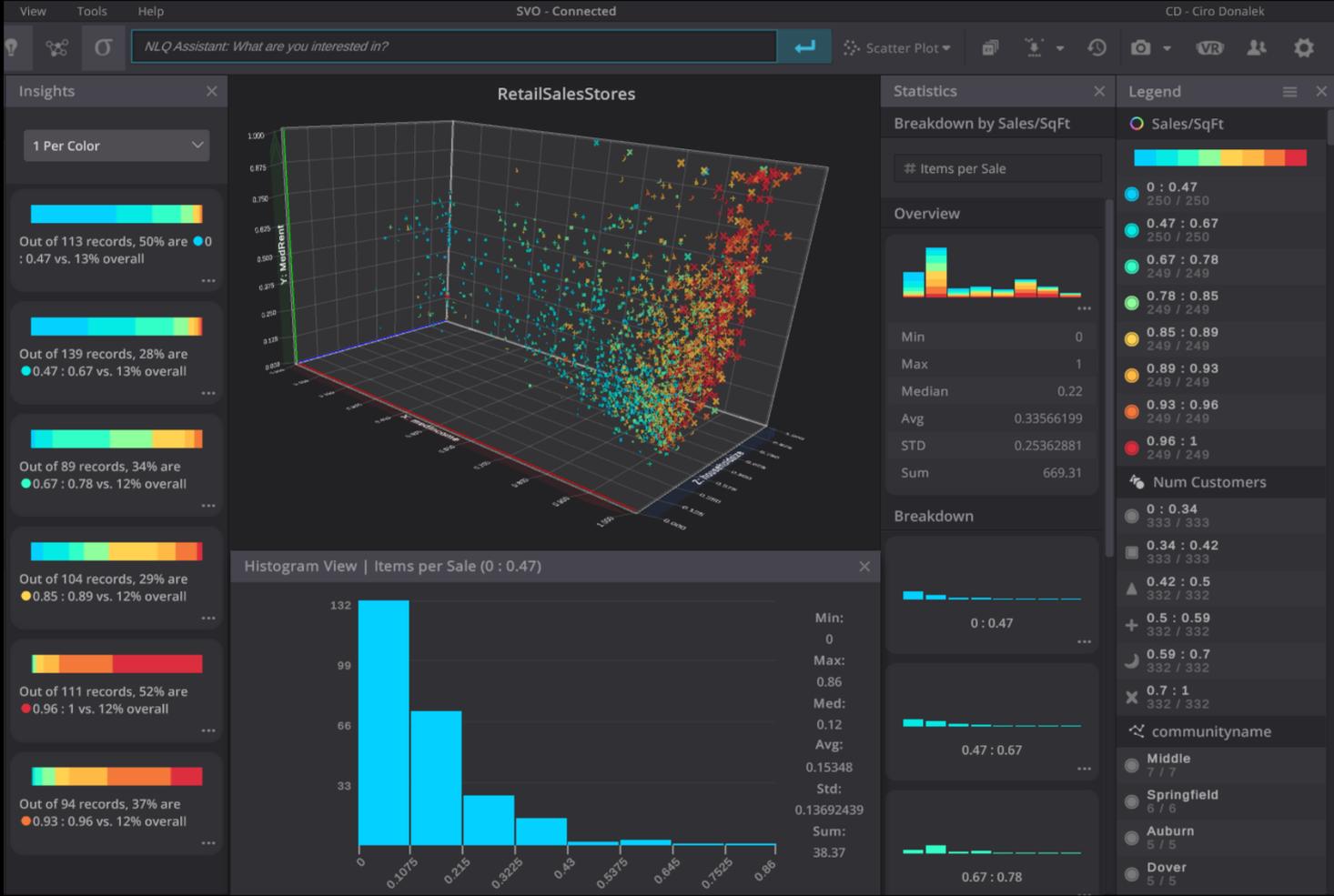
XAI: How decisions are reached

The building blocks of XAI

Explain: How results are achieved.

Interpret: Explain the meaning of results.

Visualize: Use a combination of text and visuals to offer the best experience.



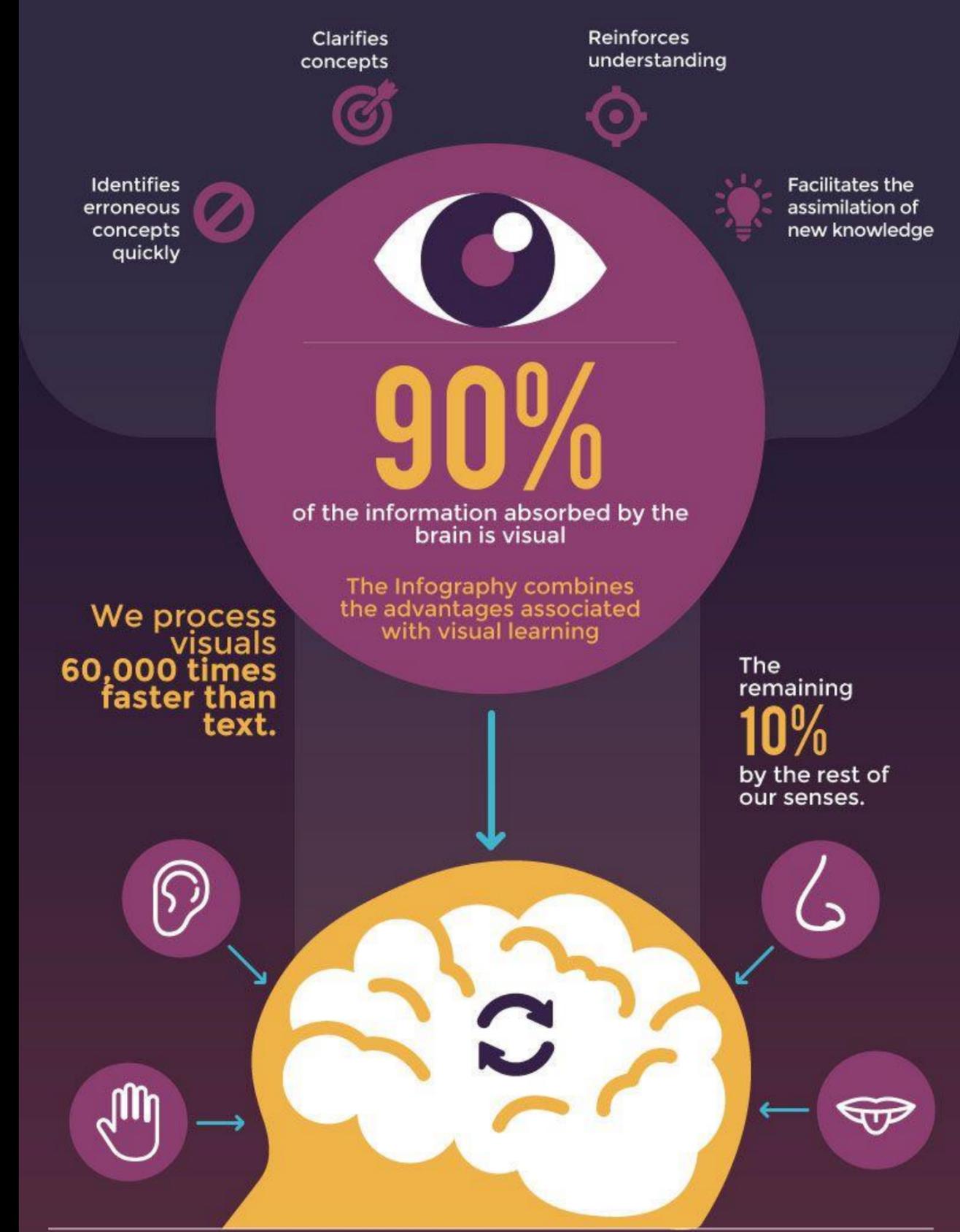
AI-driven Data Exploration

The role of visualization in eXplainable AI

Visualization helps understanding complex models, leading to greater adoption.

Clarifies concepts, reinforced understanding.

Identifies anomalies quickly.



Complex data: standard tools not enough anymore

New challenges in data analytics

Data is big, sparse, multi-dimensional, heterogeneous, coming from different sources.

Need: make sense of complex data in seconds not hours.

Data scientists are in high-demand.

Self-service data analytics tools: Empower non-data scientists through easy-to-use, embedded ML routines.



New generation of Data Analytics tools

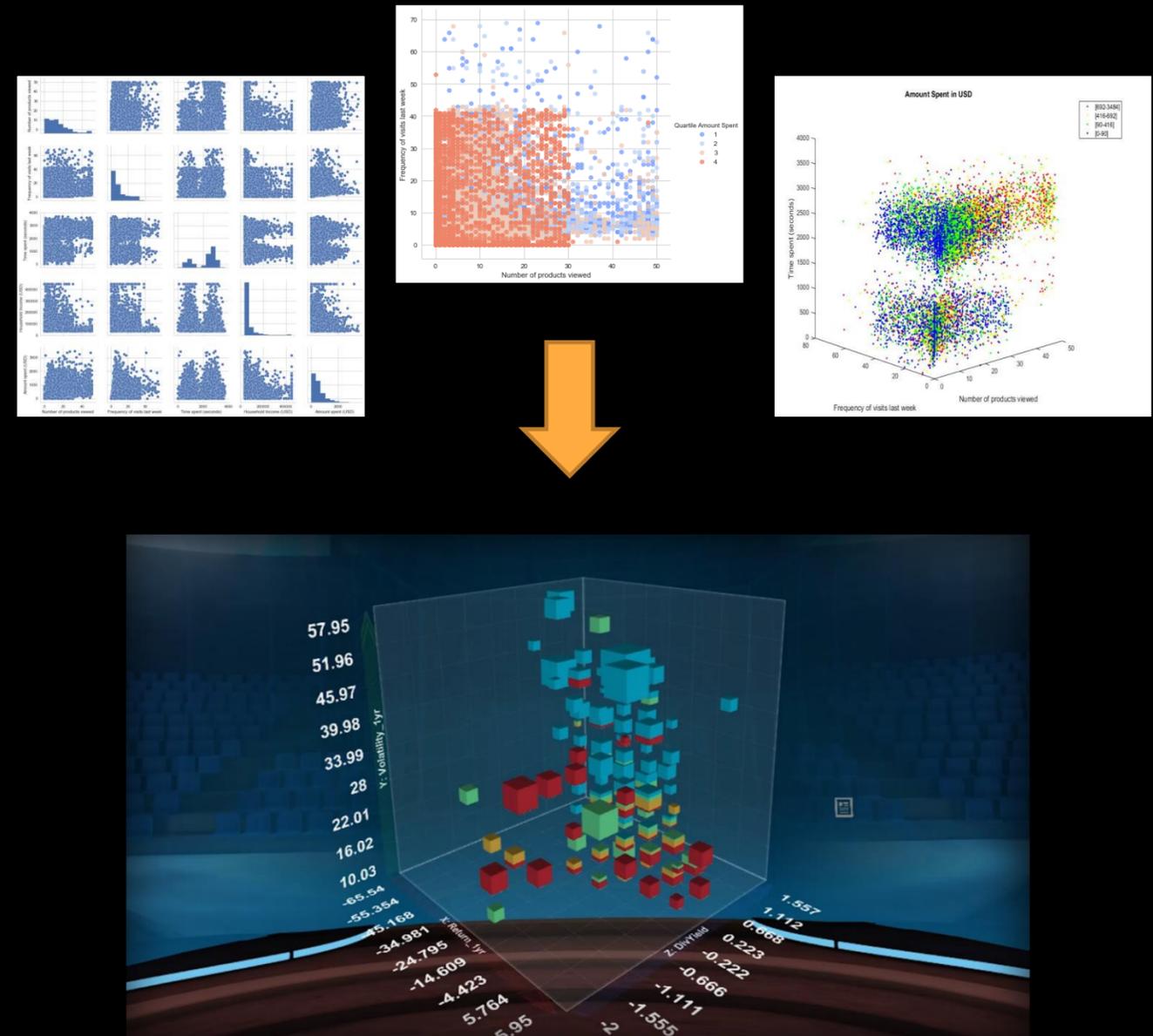
Data has evolved, BI tools haven't

Data not only big but complex, with thousands of metrics for each record.

Not easy to find and convey insights with standard tools and techniques.

Need for AI-driven analytics and data exploration.

Re-imagine the way we represent, analyze and interact with data to get key insights.



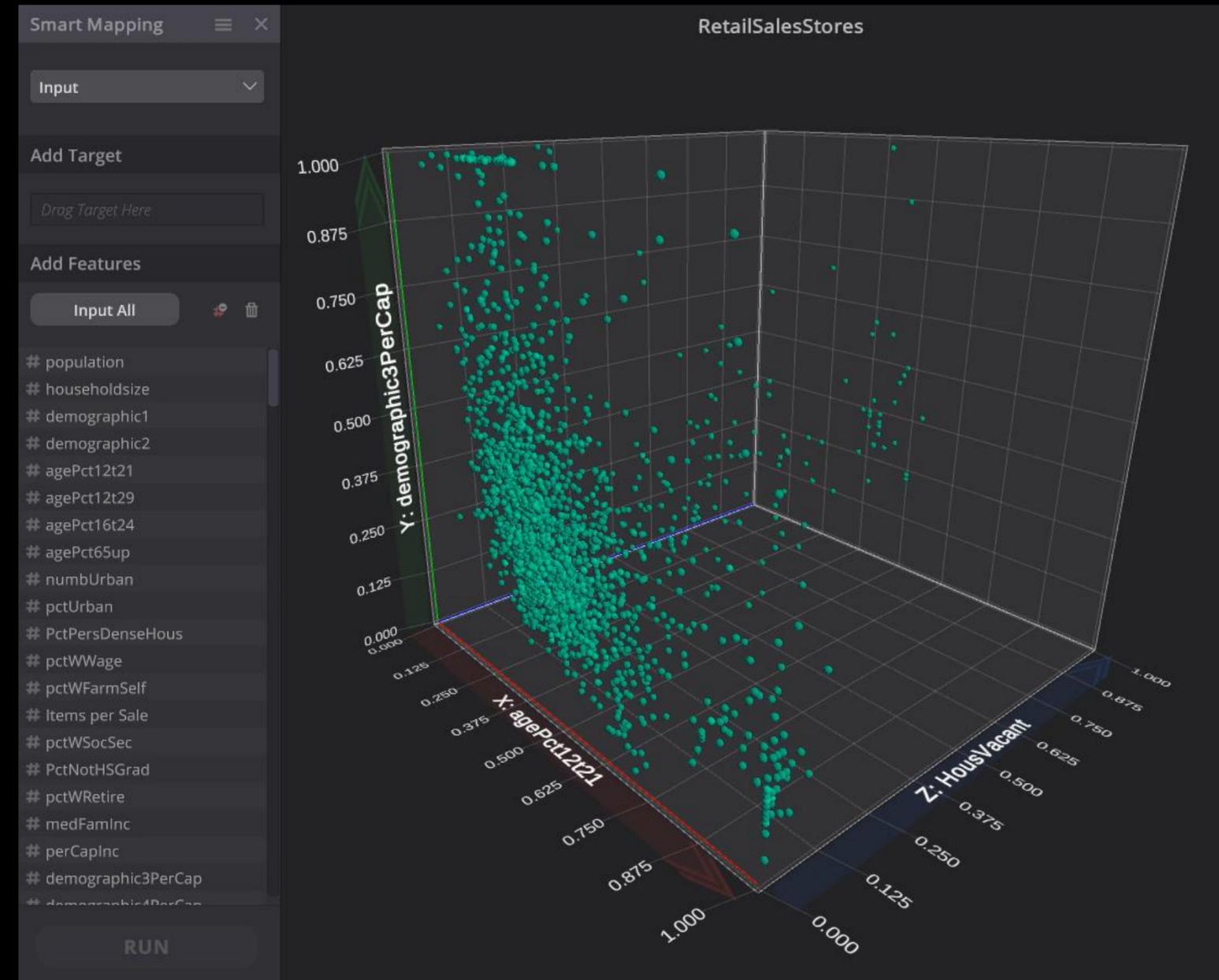
Solution: embedded, easy-to-use AI routines

AI-driven data exploration

Visualize output of complex ML models and main drivers in an intuitive way.

UI needs to be intuitive, tailored to different needs and levels of data literacy.

Data-driven Storytelling: methods and techniques to enhance the understanding of complex models and results.



Smart Mapping routine in VIP, patented.

“Systems and methods for high dimensional 3D data visualization”, Donalek C. et al.



Geospatial Analysis, Network Graphs, Advanced 3D visualizations, NLQ-assistant, embedded AI routines (e.g., Anomaly Detection, Clustering, PCA and Feature Extraction, Smart Mapping and Feature Selection).



Smart Mapping

Result 1

Features Impact

- Weighted Degree
- Louvain Community
- Latitude
- Network (1) Y
- Network (1) X
- Longitude
- Network (1) Z
- Node ID

Suggested Mappings

- Degree Scatter Plot
- Weighted Degree
- Latitude
- Network (1) Y
- Network (1) X
- Degree
- Louvain Community

APPLY

Anomaly Detection

Result 1

New Feature Created

(1) Anomaly Result

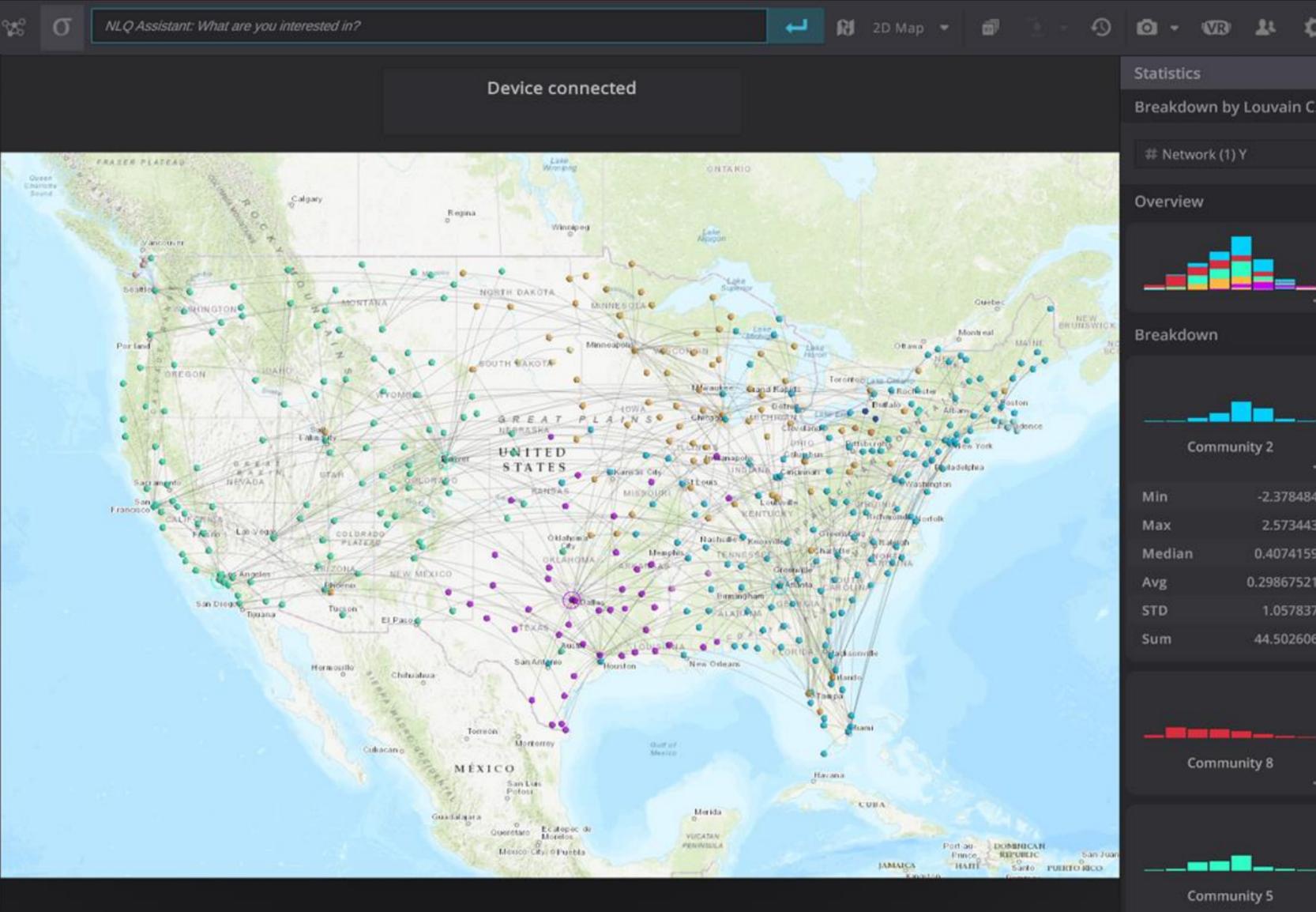
Results Summary

5 Points

Features Used (7)

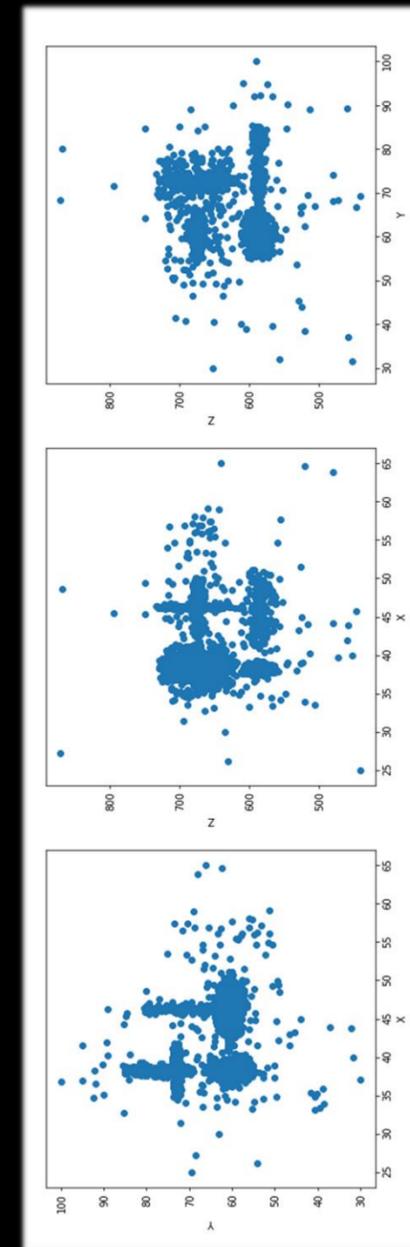
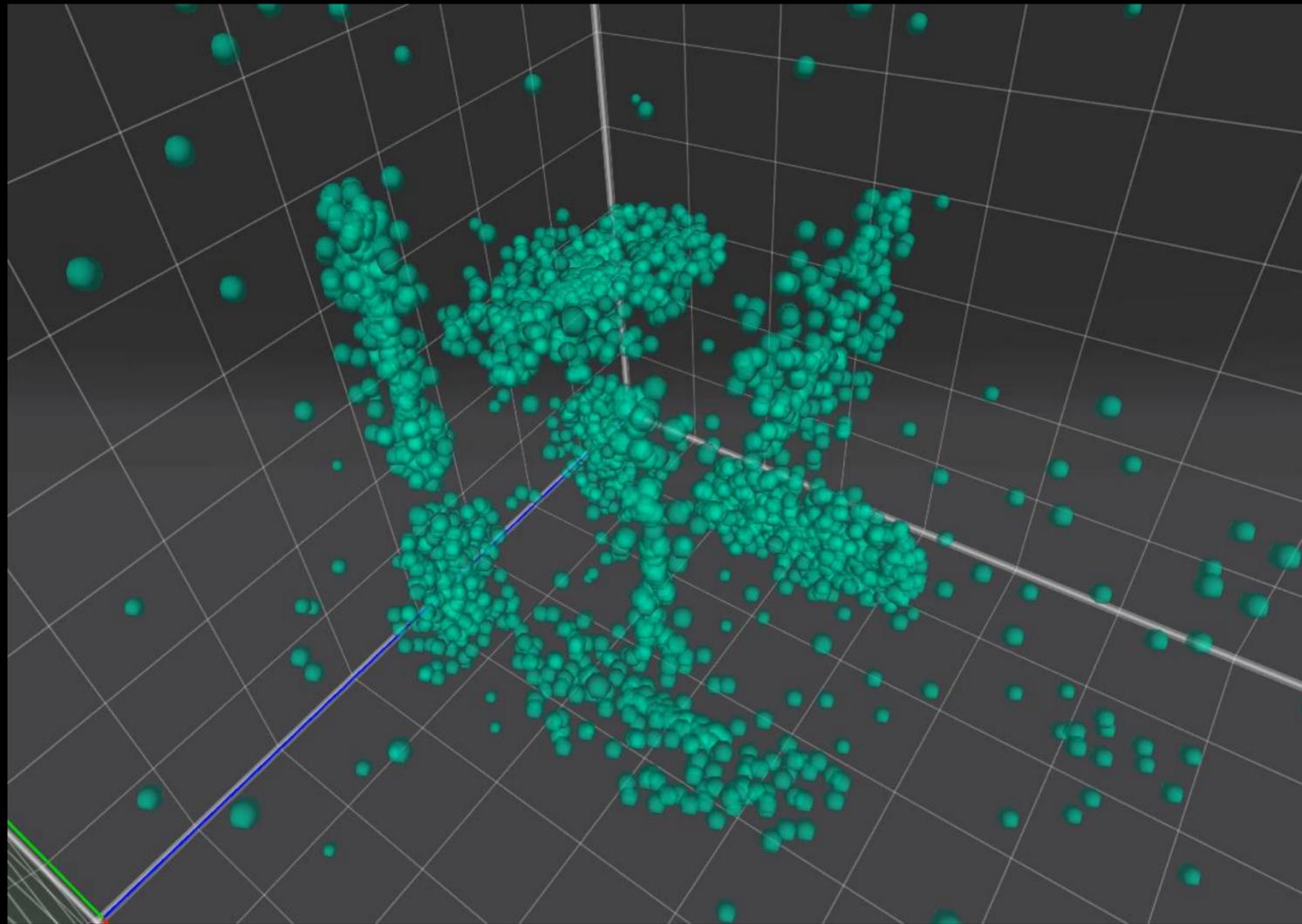
- Longitude
- Latitude
- Network (1) X
- Network (1) Y
- Network (1) Z
- Degree
- Weighted Degree

APPLIED



Advantages of multidimensional visualizations

Understand and explain complex models and insights

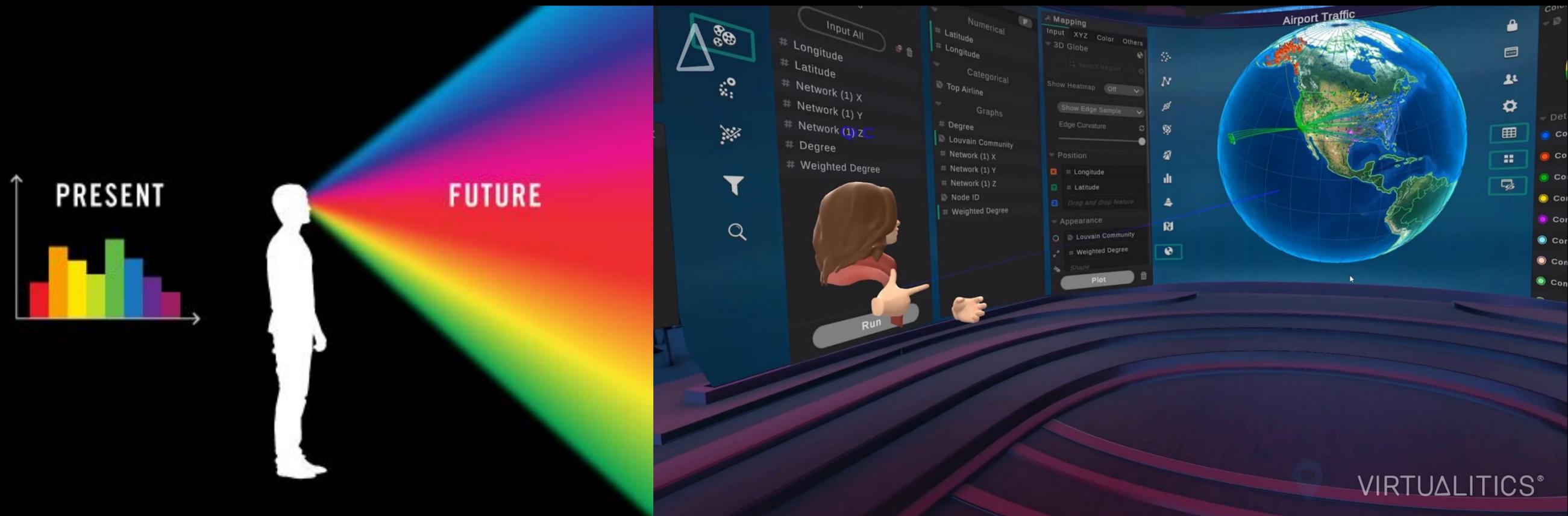


New generation of Data Analytics tools

The evolution of dashboards

Data is multi-dimensional, standard dashboards not enough anymore to understand complex relationships.

Need for AI-driven, multi-dimensional, collaborative and immersive visualization tools.

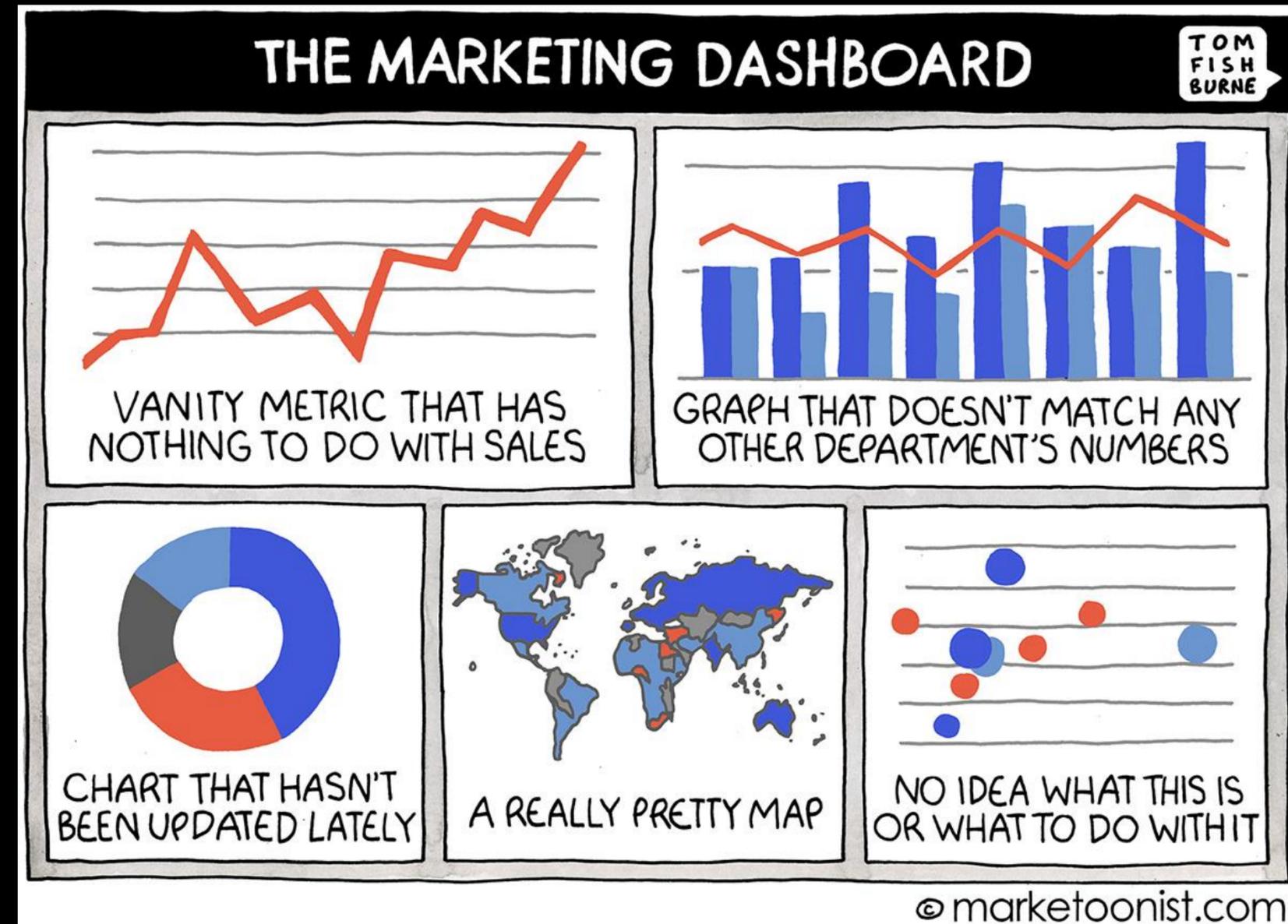


Gartner Report, October 2020

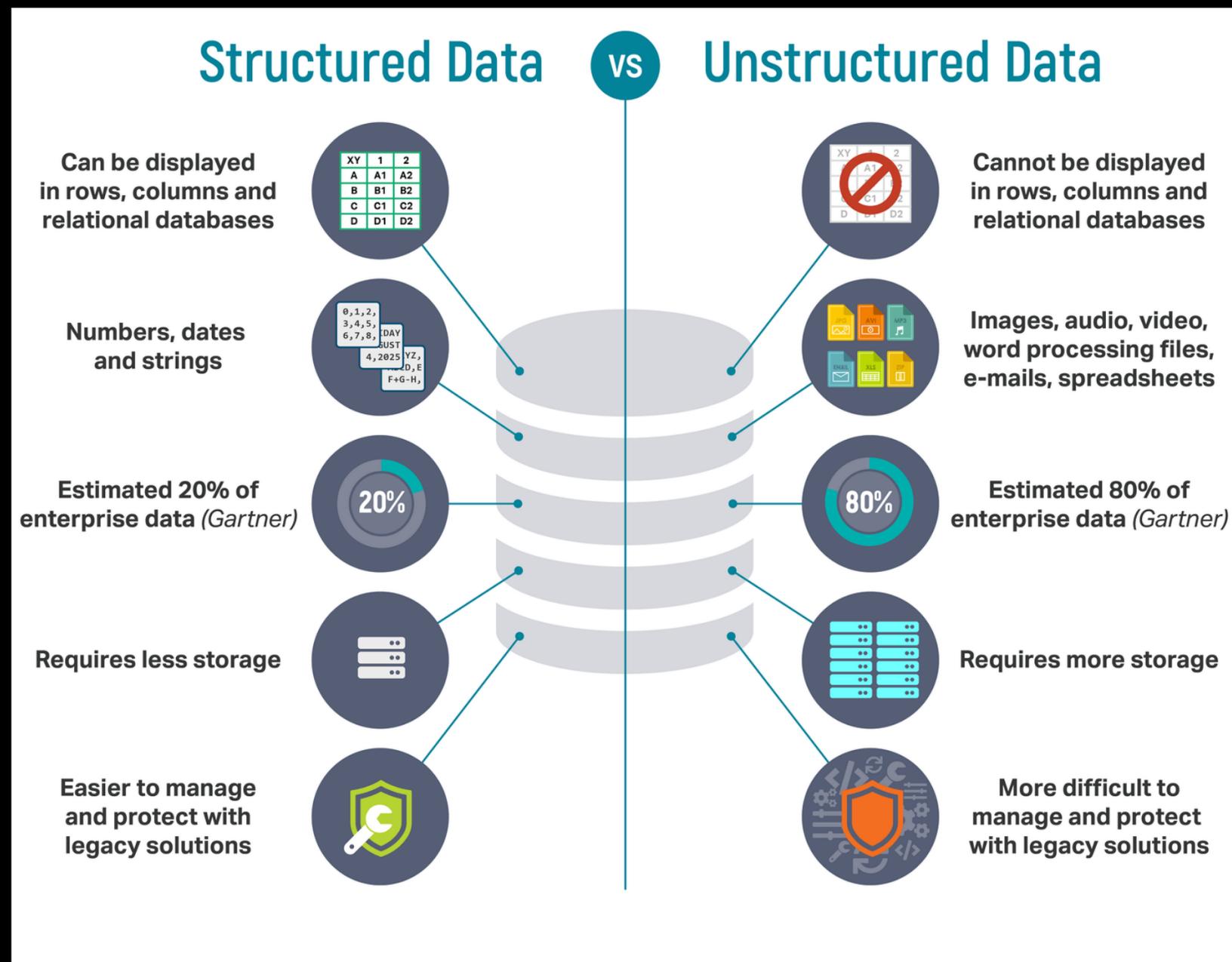
Trend 2: Decline of the dashboard

"Dynamic data stories with more automated and consumerized experiences will replace visual, point-and-click authoring and exploration."

"Data and analytics leaders need to regularly evaluate their existing analytics and business intelligence (BI) tools and innovative startups offering new augmented and NLP-driven user experiences beyond the predefined dashboard."



Adding more complexity: The rise of Unstructured Data



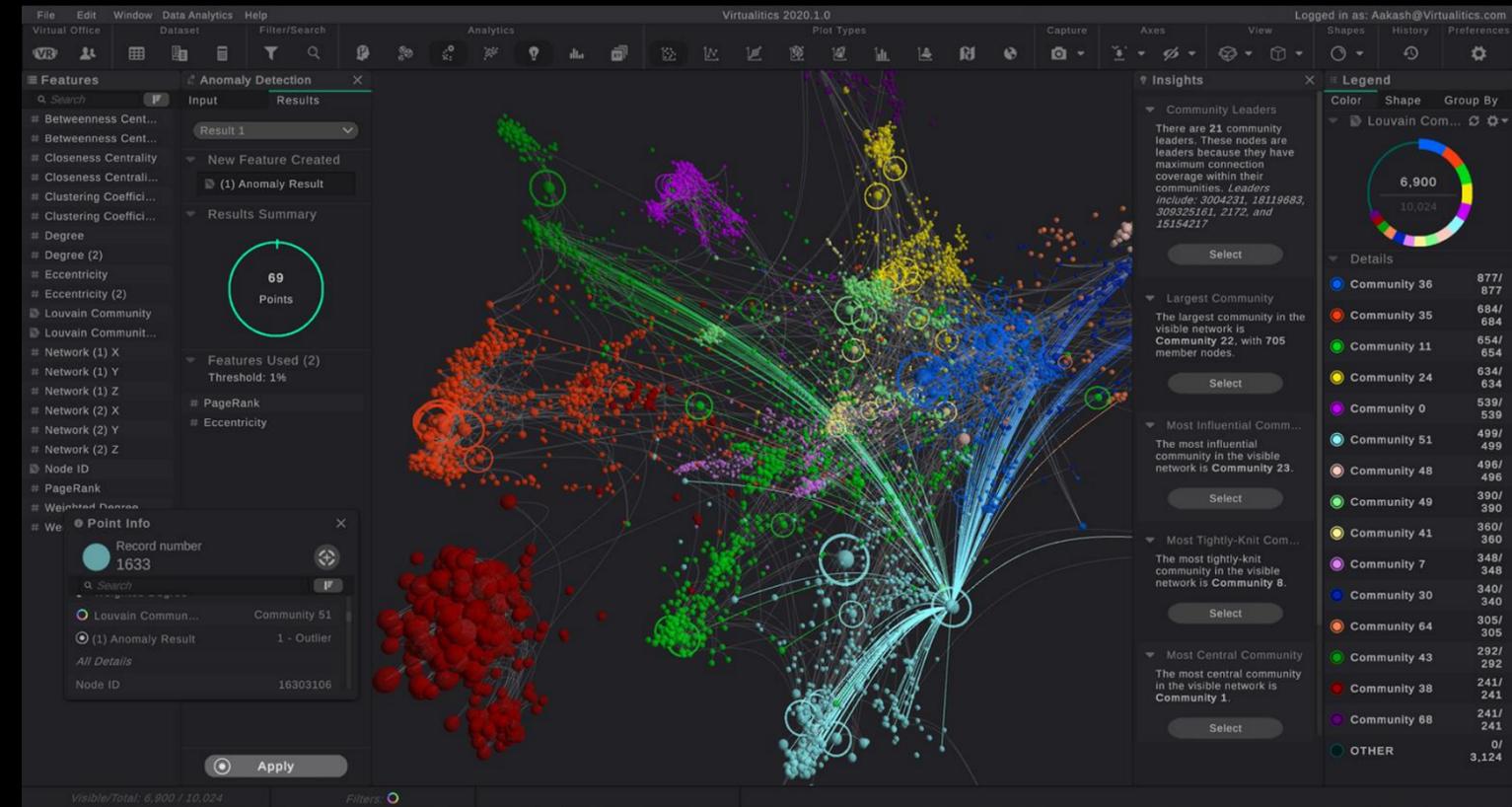
Gartner Report, October 2020

Trend 10: Graph Analytics

"By 2023, graph technologies will facilitate rapid contextualization for decision making in 30% of organizations worldwide."

"It helps data and analytics leaders find unknown relationships in data and review data not easily analyzed with traditional analytics."

"Consider investigating how graph algorithms and technologies can improve your AI and ML initiatives."



Network graphs in VIP: GPU accelerated, AI-driven, interactive.

Enhanced data storytelling: multi-scale visualizations



Black Box Analysis using nLP

Natural Language Processing (NLP) is the use of computers to process human language in order to accomplish a task.

Natural Language Querying (NLQ) is an NLP method that domain experts and stakeholders can use to query a black box model.

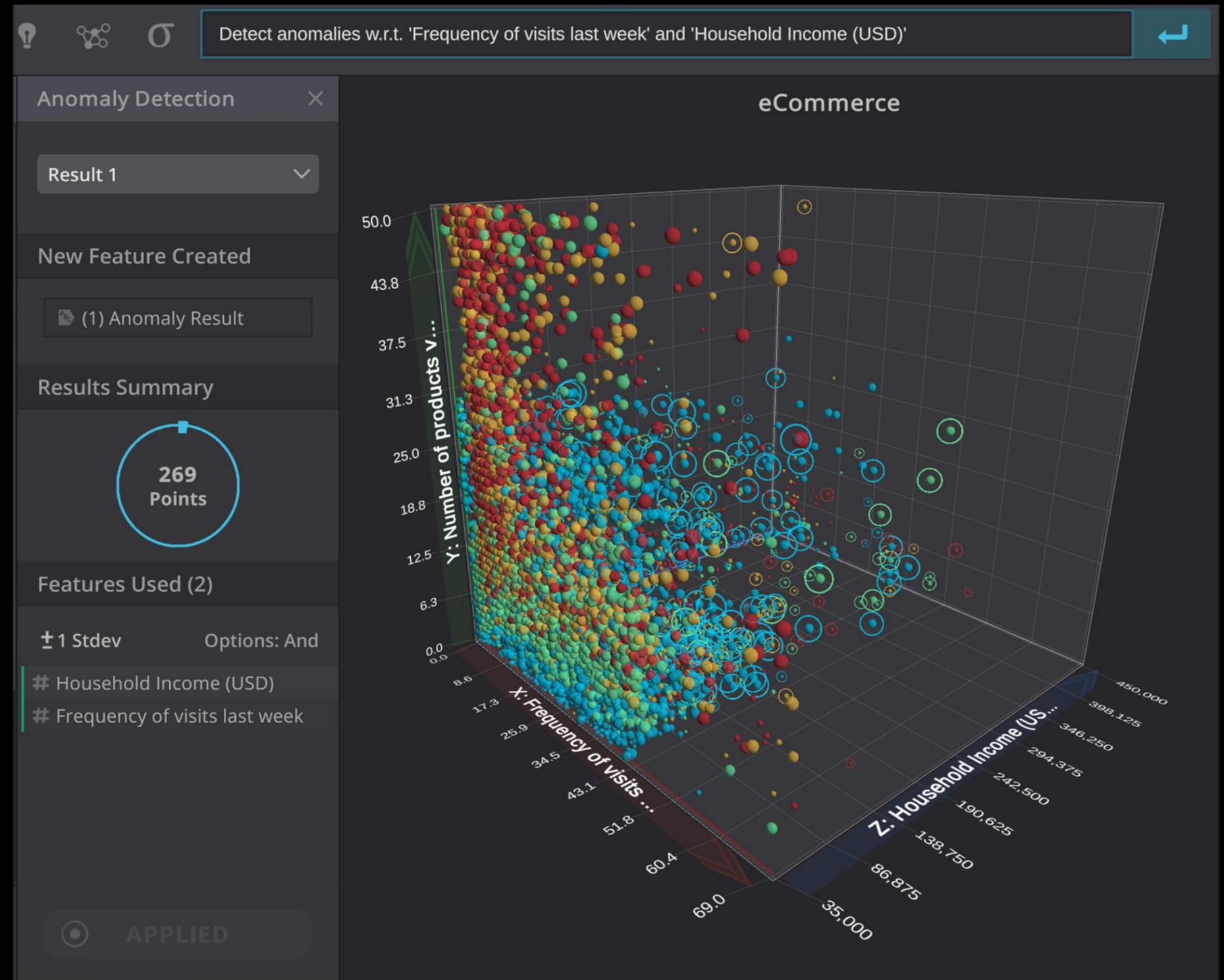
A good NLQ system enables users to form queries that leave out some details or that are otherwise ambiguous, and employs an AI engine to fill in the gaps.

nLP: Querying the Black Box

Successful interrogation of a blackbox model requires *asking the right questions* about how the inputs relate to the outputs.

Domain Experts often know the best questions to ask.

Interrogating the model using natural language enables domain experts to ask the right questions.

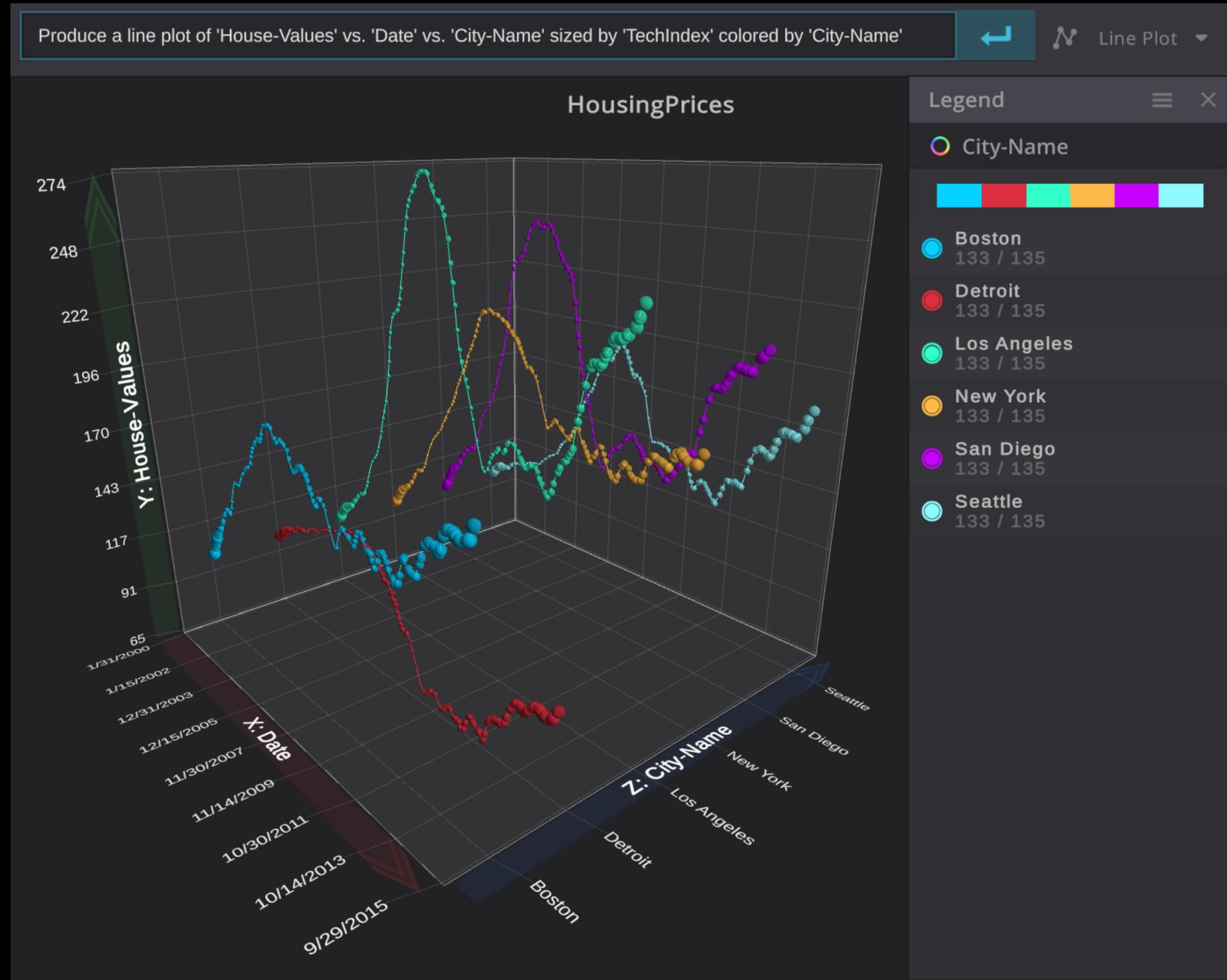


nLP: Natural Language Querying

Natural language queries are transparent to other participants, including stakeholders.

No prior knowledge of the user-interface is required so anyone can adjust the query.

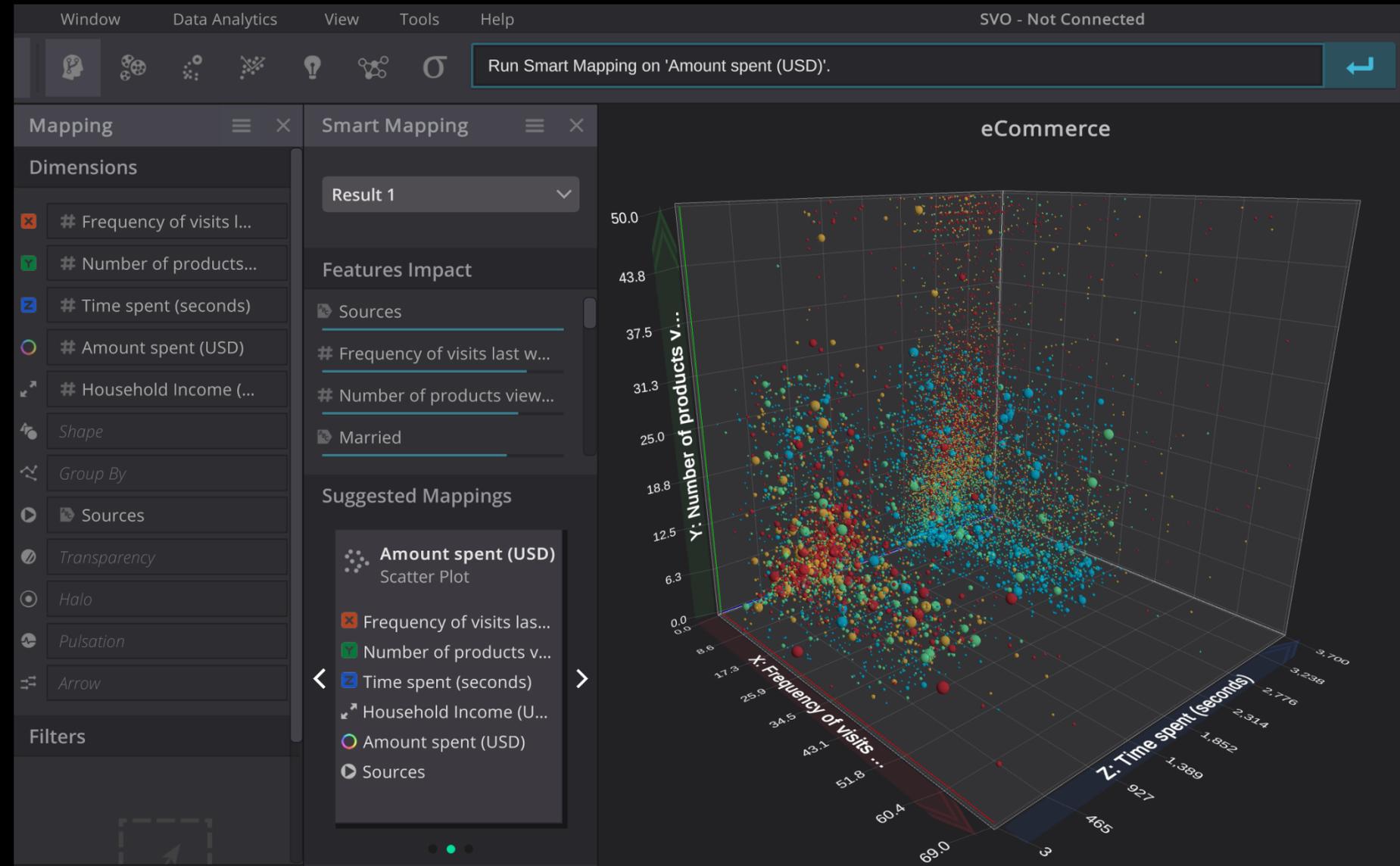
Gradually exposes relevant aspects of the user-interface.



nLP: Natural Language Querying

Natural language queries enable users to express their intent without filling in all the details and allow for ambiguity.

Key Insight: Use Artificial Intelligence to fill in the details or to resolve ambiguity in a natural language query.



nLP: Natural Language Querying

Queries allow users to express intent in different ways – e.g.:

Running Smart Mapping

- *“What drives 'Amount spent (USD)’?”*
- *“Smart Mapping on 'Amount spent (USD)' using 'Age', 'Page visits', 'Number of visits last month' and 'Kids’.”*

Detecting Anomalies

- *“Identify outliers”*
- *“Detect anomalous points from 'Age', 'Number of visits last month' and 'Page visits’”*

Clustering

- *“Cluster”*
- *“Create 5 clusters”*
- *“Create clusters using every feature except 'Age', 'Number of visits last month' and 'Page visits’.”*

Extracting a Network Graph

- *“Construct a Network of 'User ID’.”*
- *“Construct a Network of 'User ID' without 'Hobby’.”*

NLP: AI Guided Suggestions

Suggest queries generated by an Artificial Intelligence engine that analyzes the user's data.

Suggest completions of the query the user is writing.

List alternative queries based on the intent of the current query.

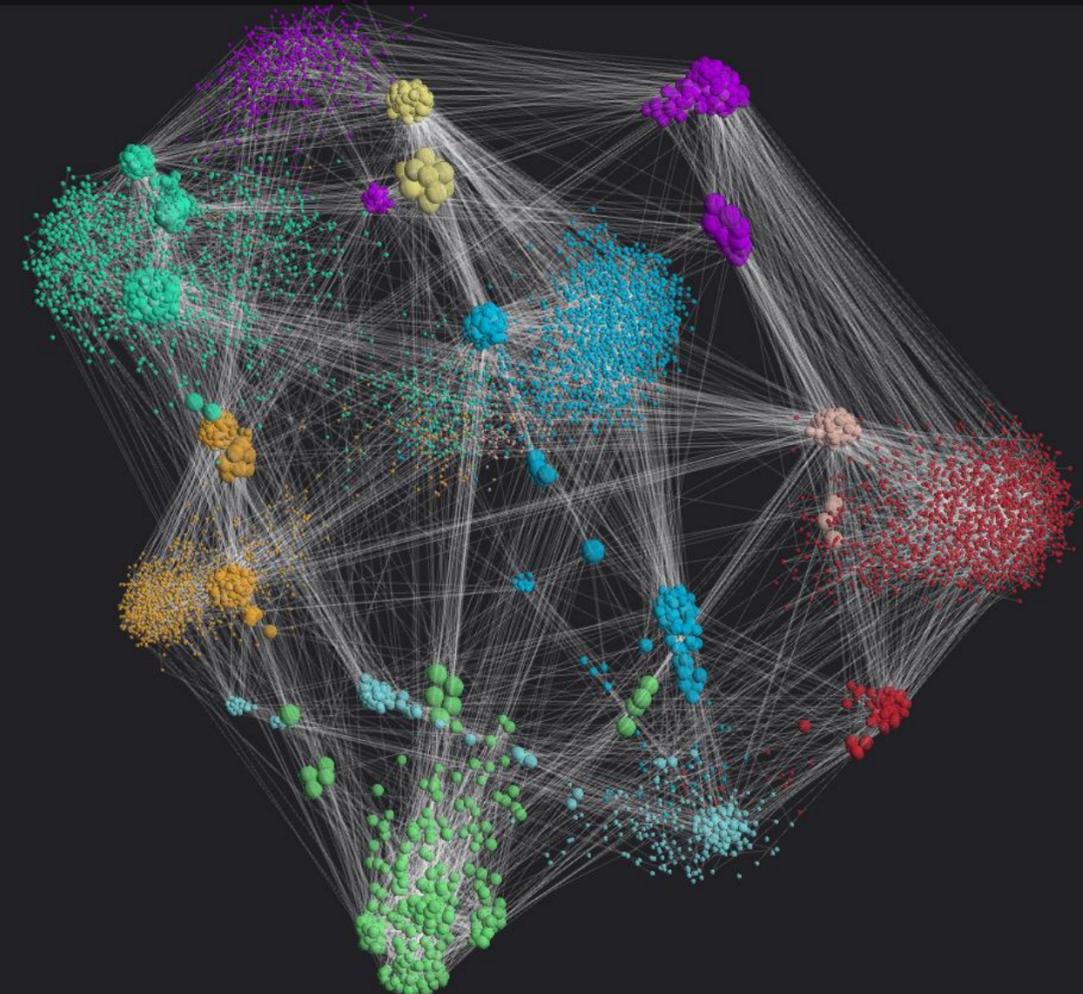
NLQ Assistant: What are you interested in?

Try one of the suggested queries below.

"Run Smart Mapping on 'Louvain Community' using 'Mean_Age', 'Mean_First visit to site (months ago)', 'Mean_La...

"Run Smart Mapping on 'Degree'." will run Smart Mapping.

"Detect Anomalies with respect to 'Weighted Degree'" will run AnomalyDetection.

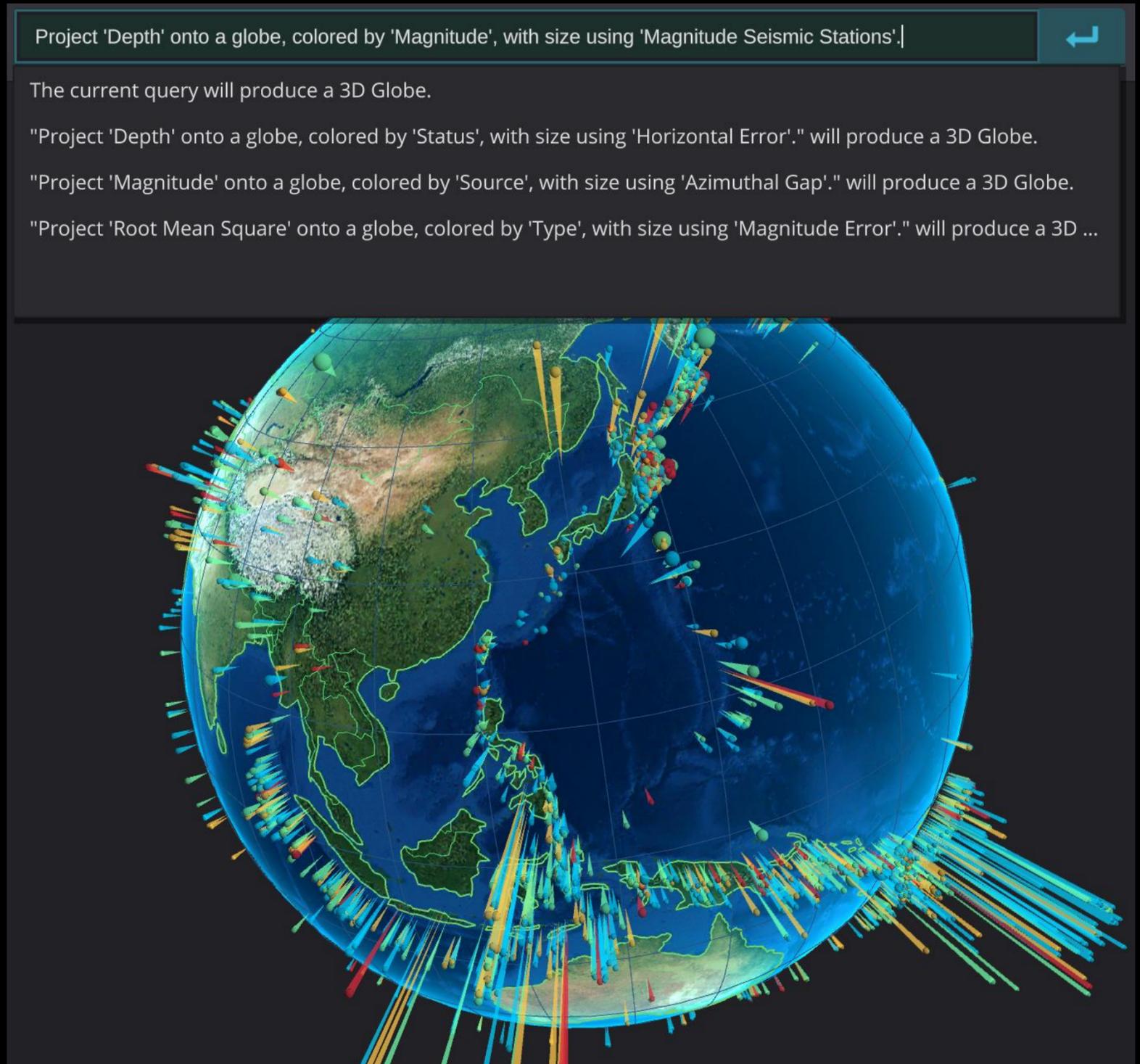


NLP: AI Guided Suggestions

Key Insights:

Users should expect to work hand in hand with an AI engine that they communicate with using natural language.

Users should always be able to turn to the AI for guidance on what to do next in analyzing the model.

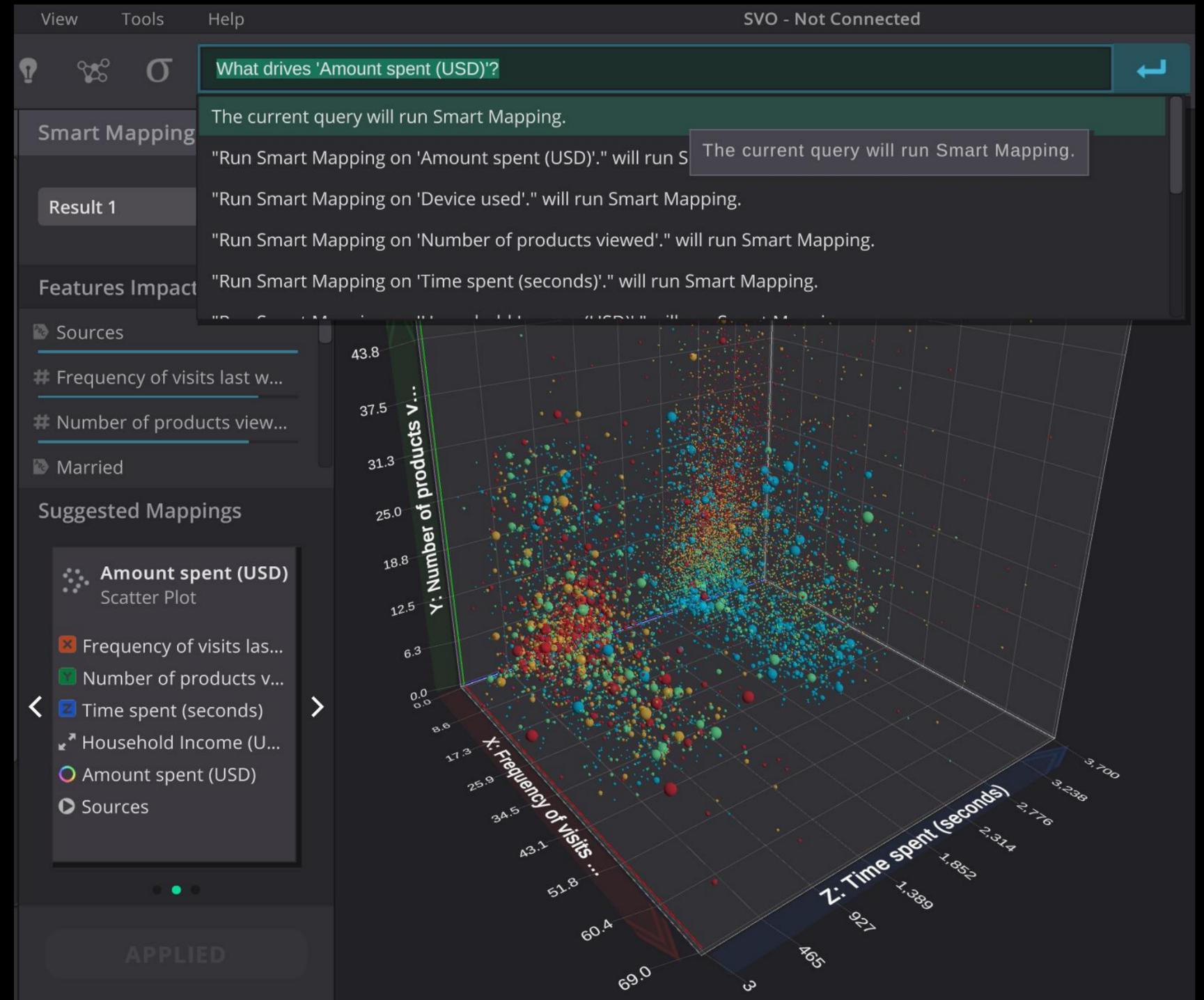


NLP: Extended Queries

Users will always come up with novel phrasing that your system cannot handle.

Key Insight: Handle queries that cover the ways your system can interrogate a model, and let users map novel phrasing to phrases your system supports.

Users can then *customize your system to their domain* – this makes queries easier to use and comprehend by other domain experts or stakeholders so that they can more easily interrogate the model themselves.



Contacts

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🔗 Request free trial:
<https://www.virtualitics.com>

