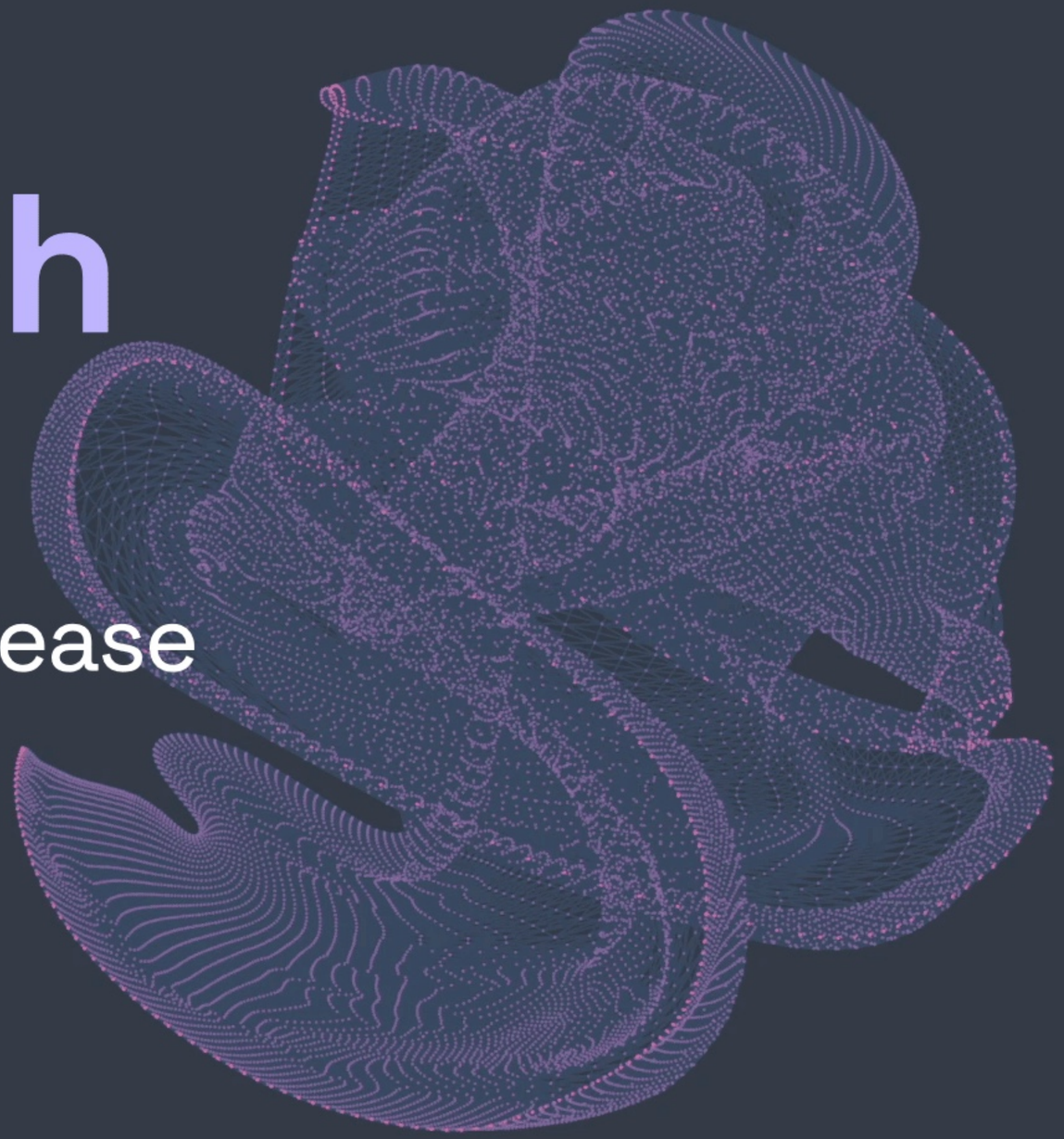
Stanford University, April 2026

cosmograph



Visualizing large graphs and AI embeddings with ease

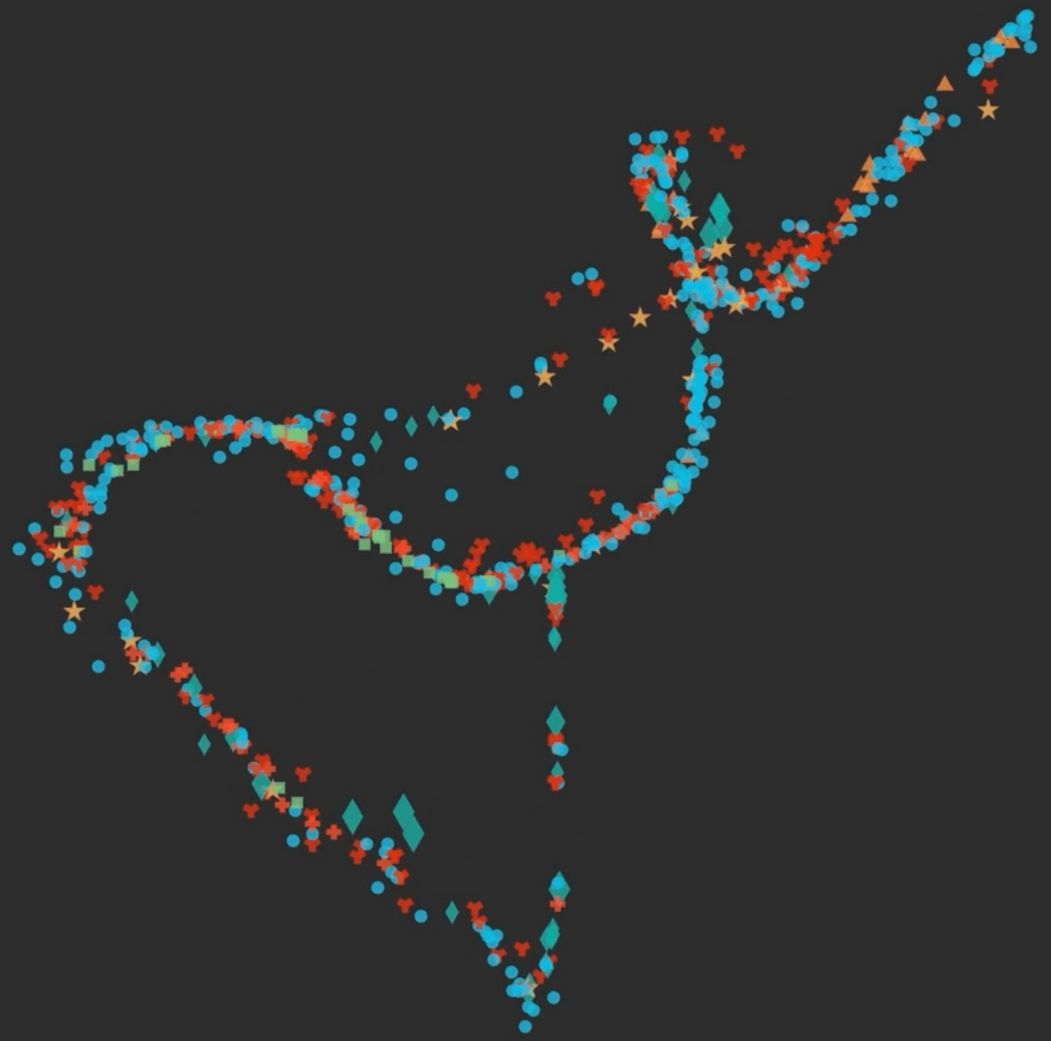
https://rokotyan.com/cosmograph-stanford-2026.pdf

Nikita Rokotyan
rokotyan.com

LinkedIn: rokotyan

👋 Hi, I'm Nikita

I create tools to work with data



cosmograph.app
interacta.io
unovis.dev
marketmap.one

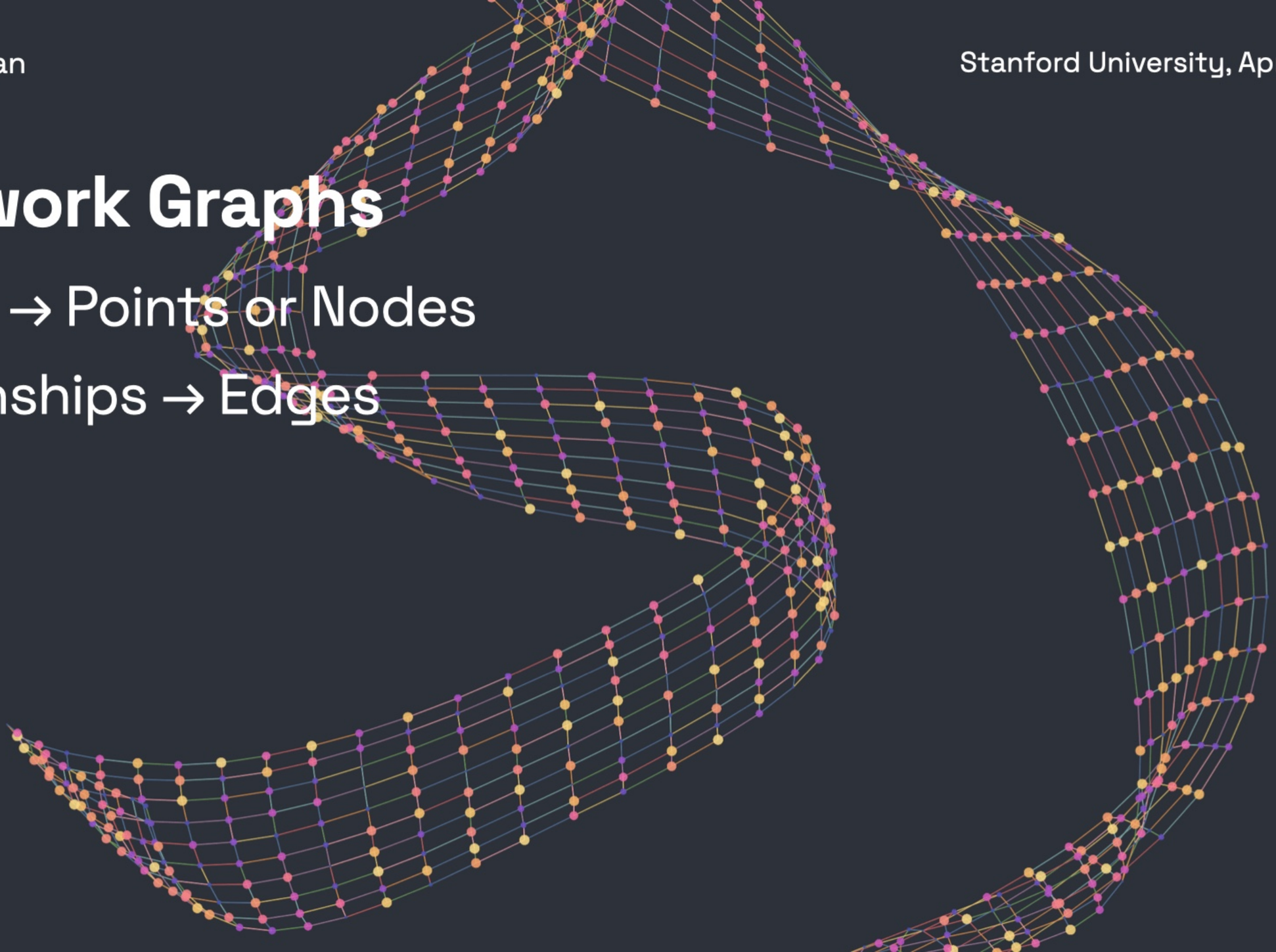
Nikita Rokotyan
rokotyan.com

LinkedIn: rokotyan

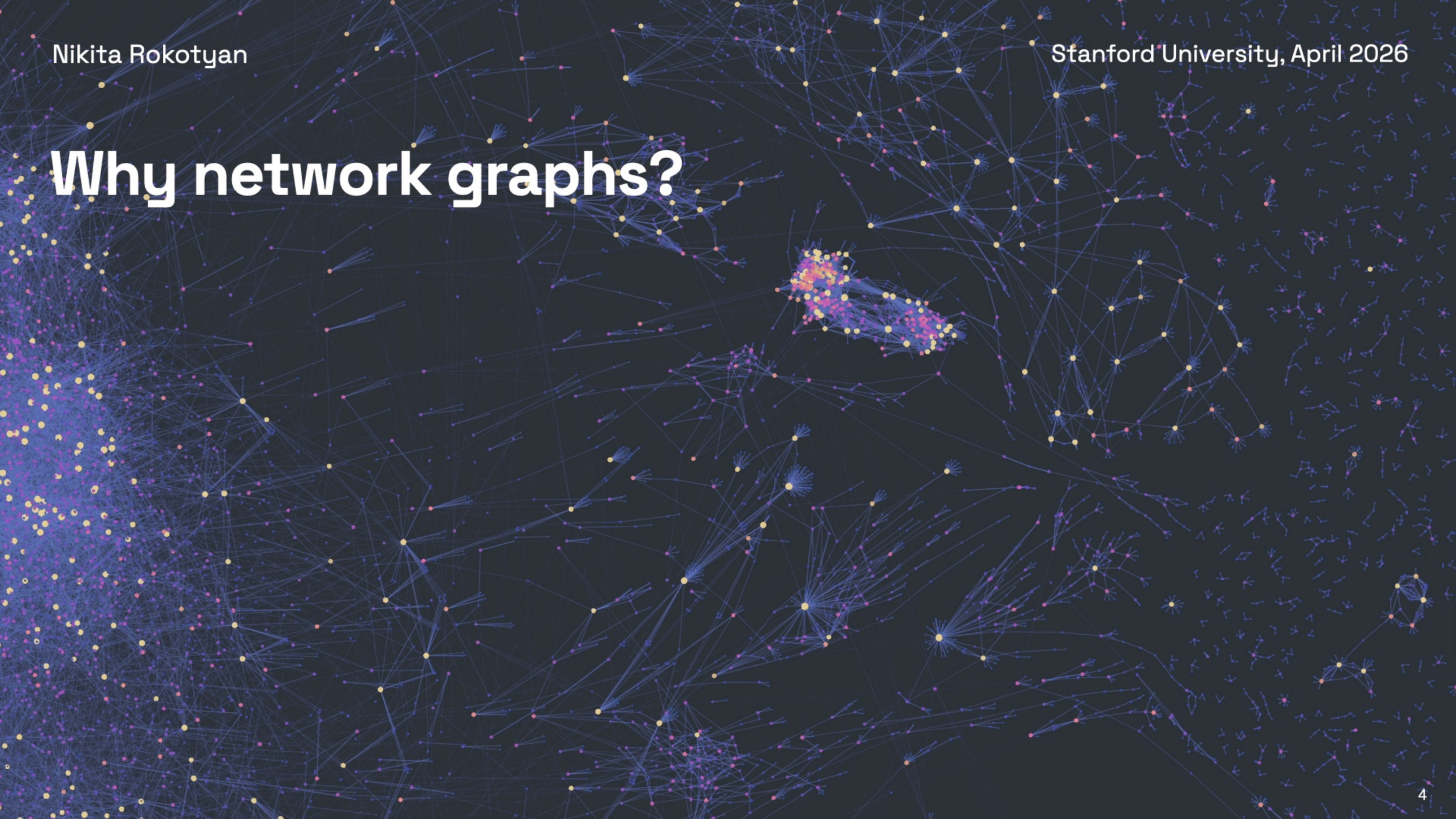
I. Network Graphs

Entities → Points or Nodes

Relationships → Edges



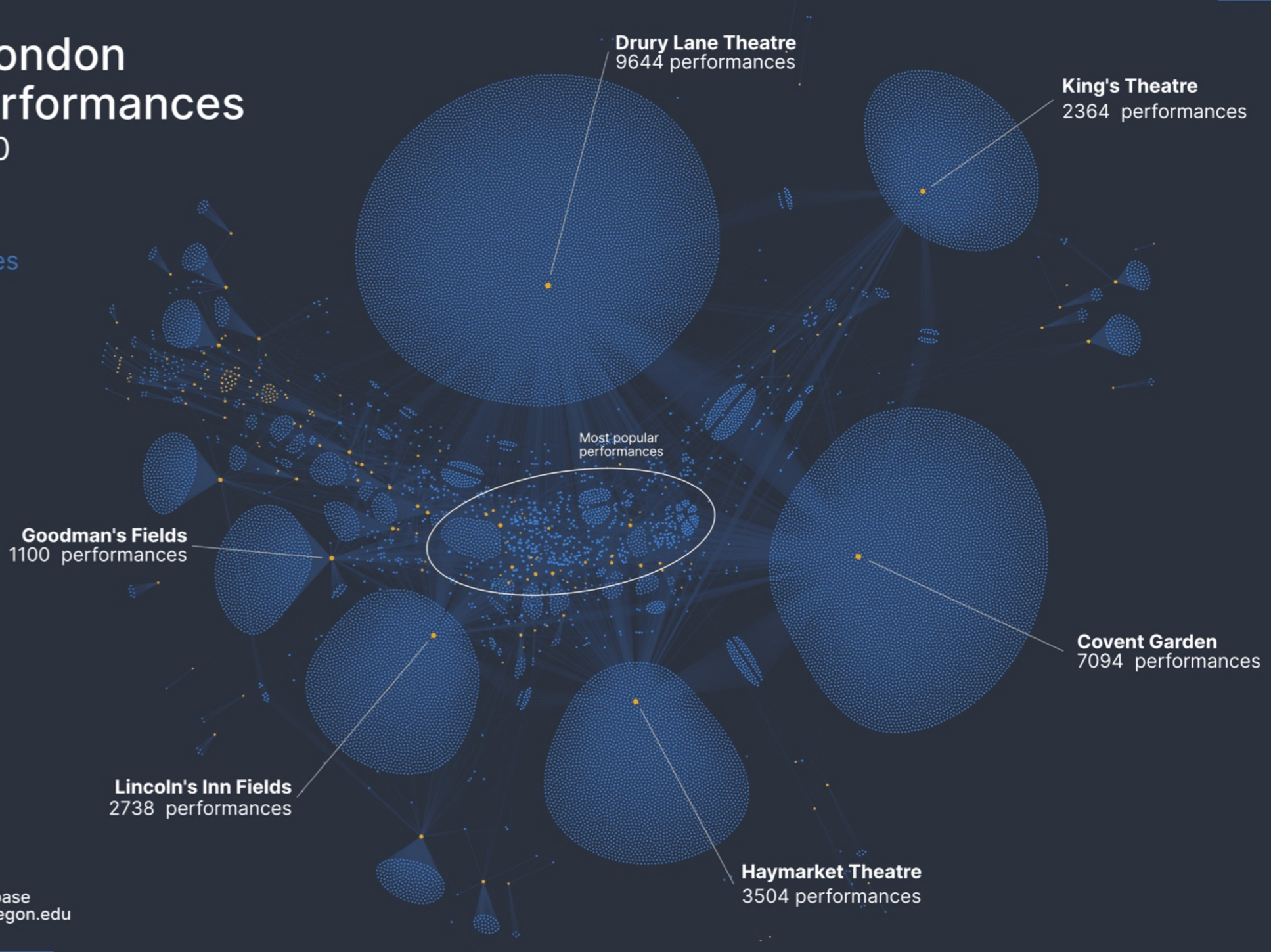
Why network graphs?



A graph of London theatrical performances

from 1660 to 1880

- 240 Theaters
- 30 246 Performances



Created with Cosmograph
by @ernaem

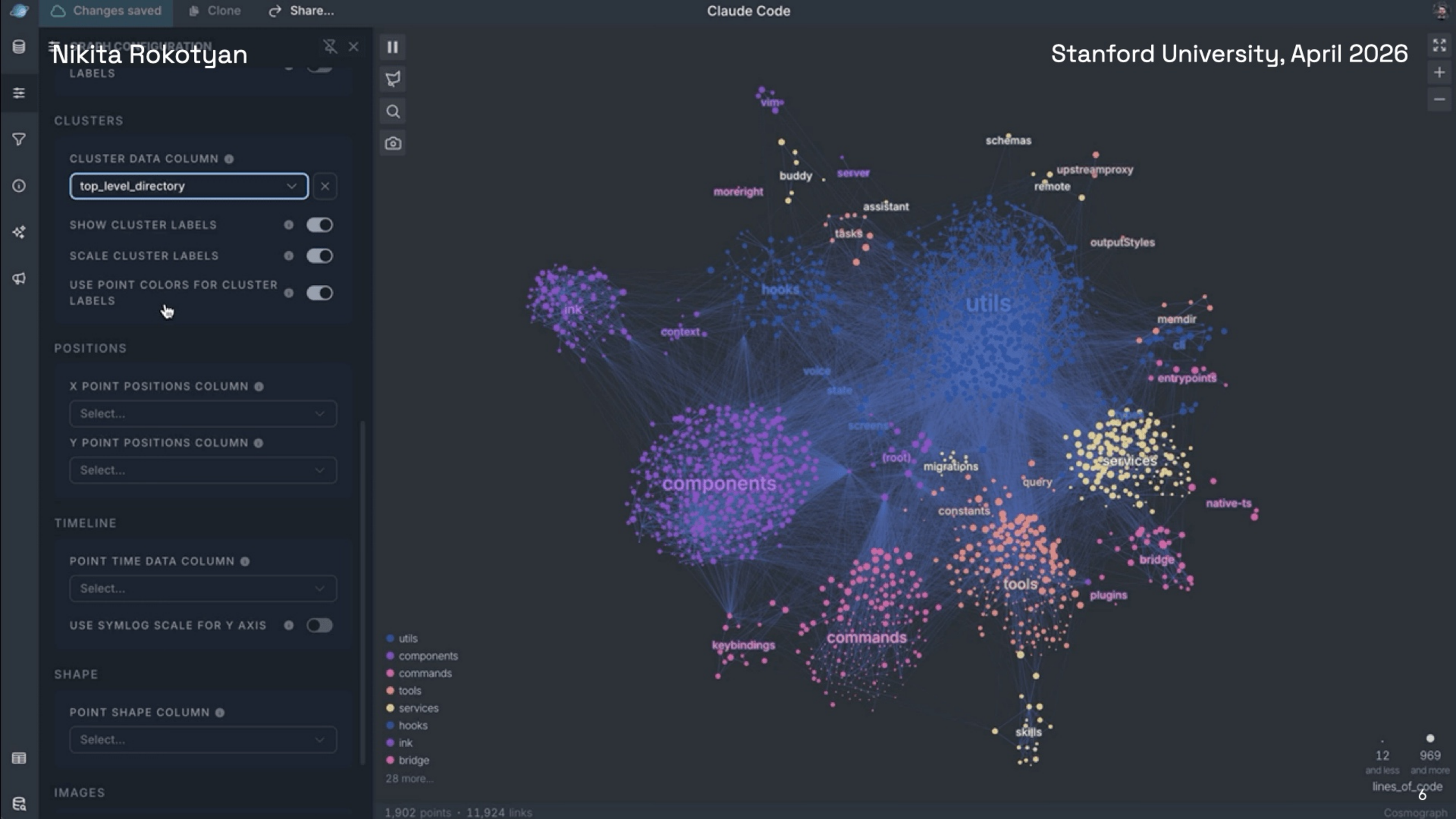
Data Source: London Stage Database
https://londonstagedatabase.uoregon.edu

Changes saved | Clone | Share...

Claude Code

Nikita Rokotyan

Stanford University, April 2026



How to build a network graph?

1. Define Relationships
2. Choose the layout
3. Draw and analyze!

Layout Types

Geo

Hierarchies

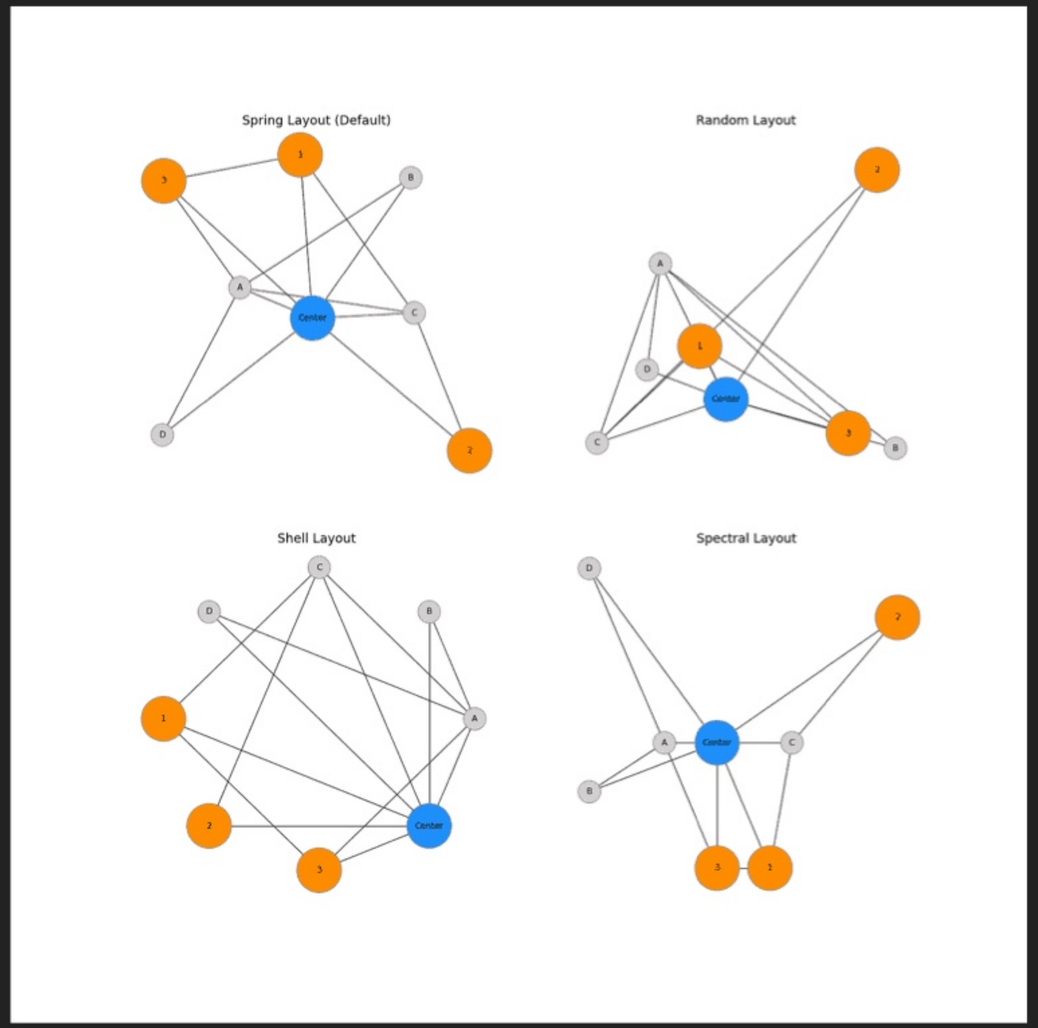
Columns

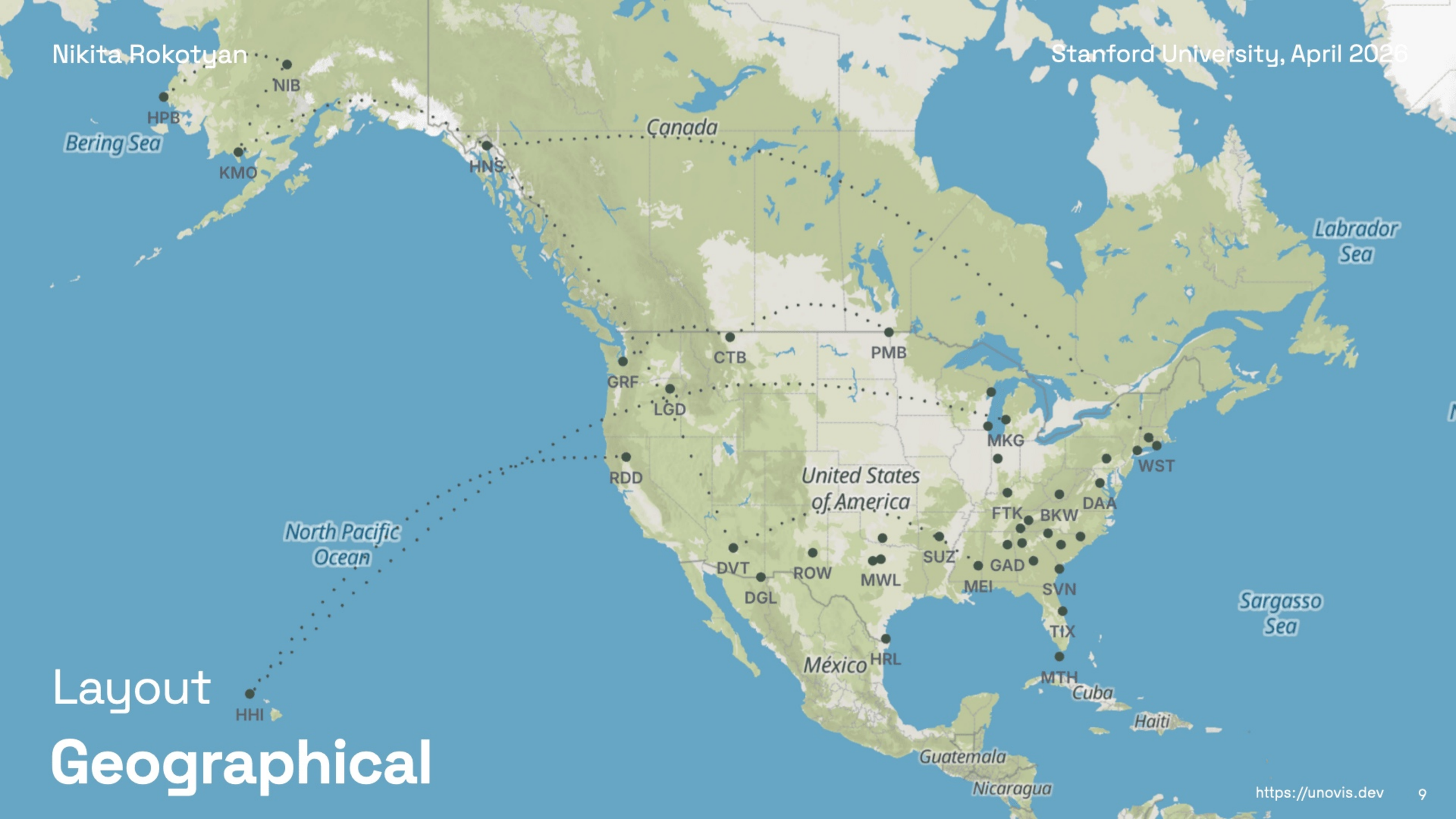
Force Graph

Spectral

Circular

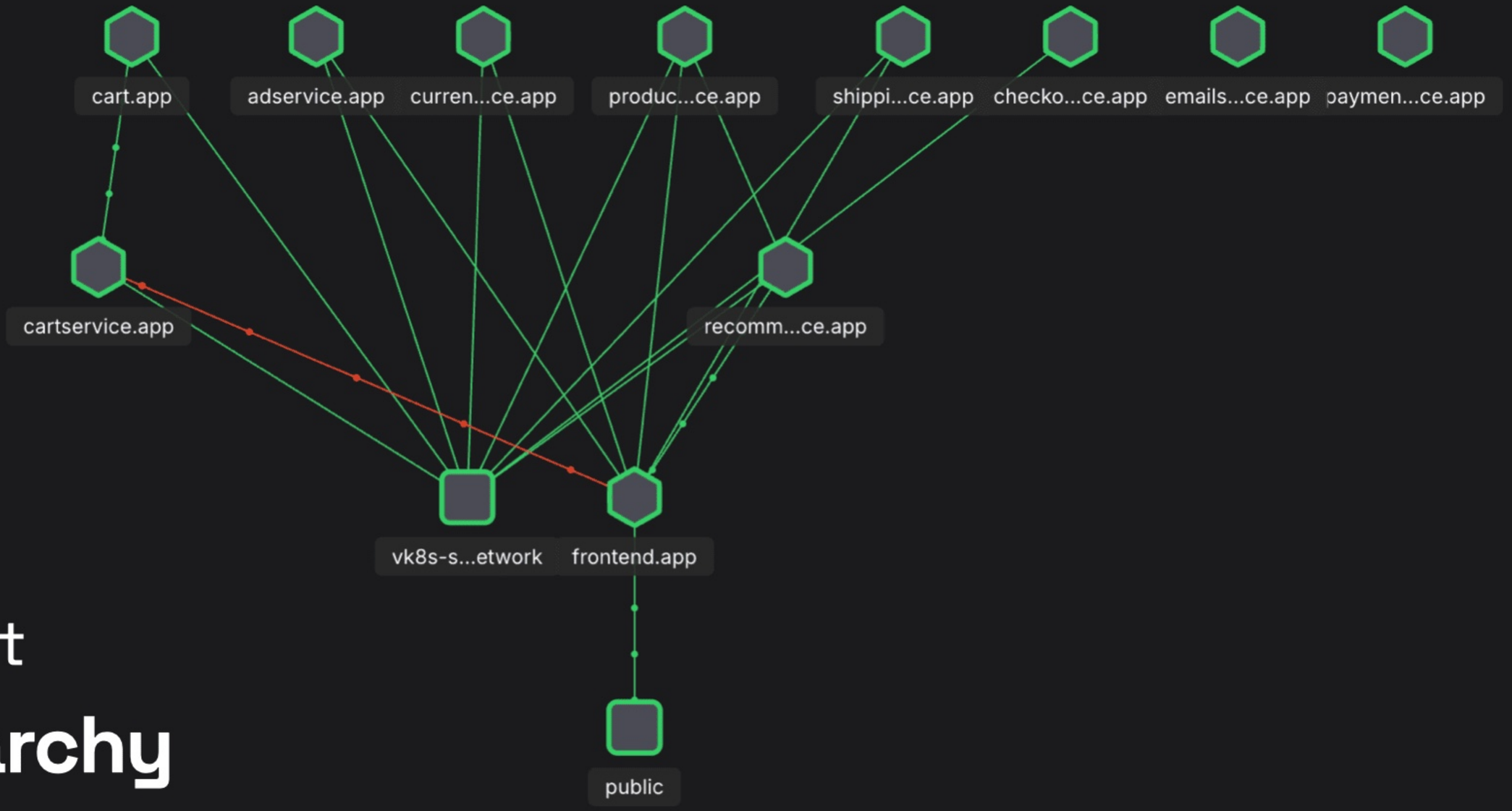
...





Layout

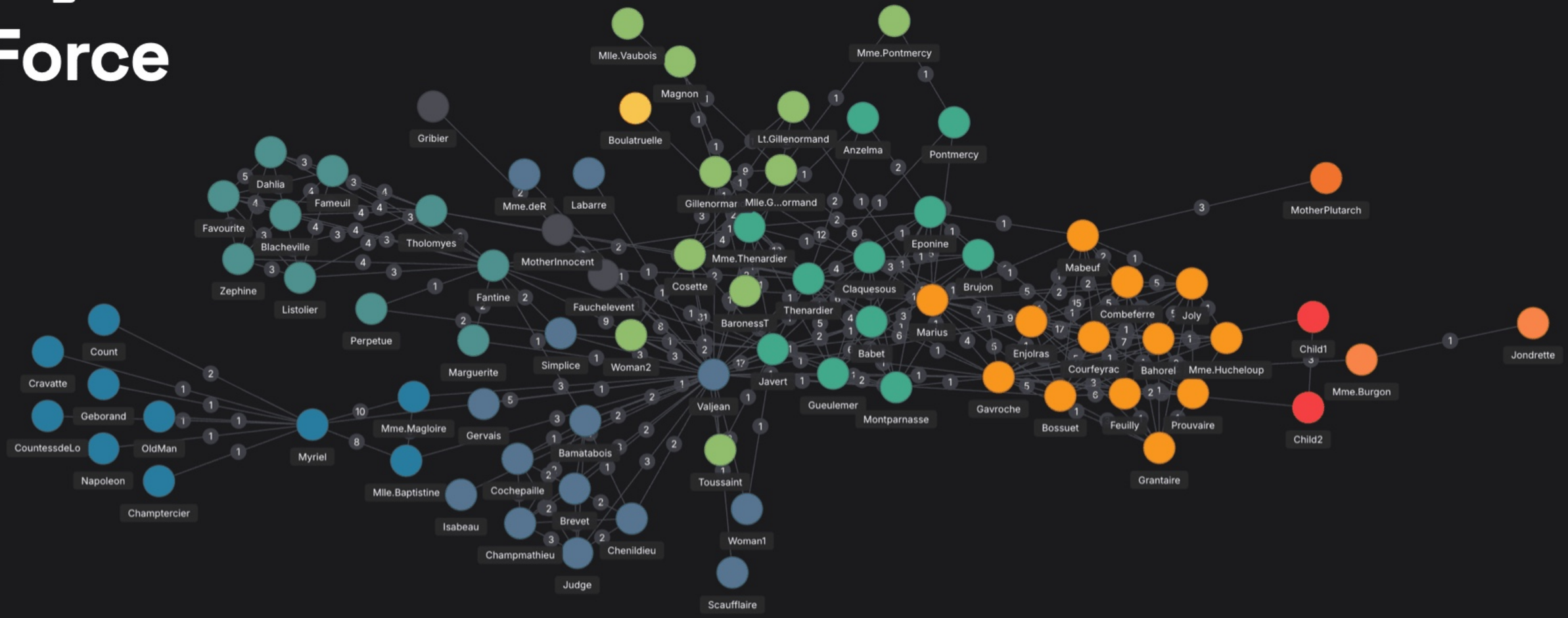
Geographical



Layout

Hierarchy

Layout
Force

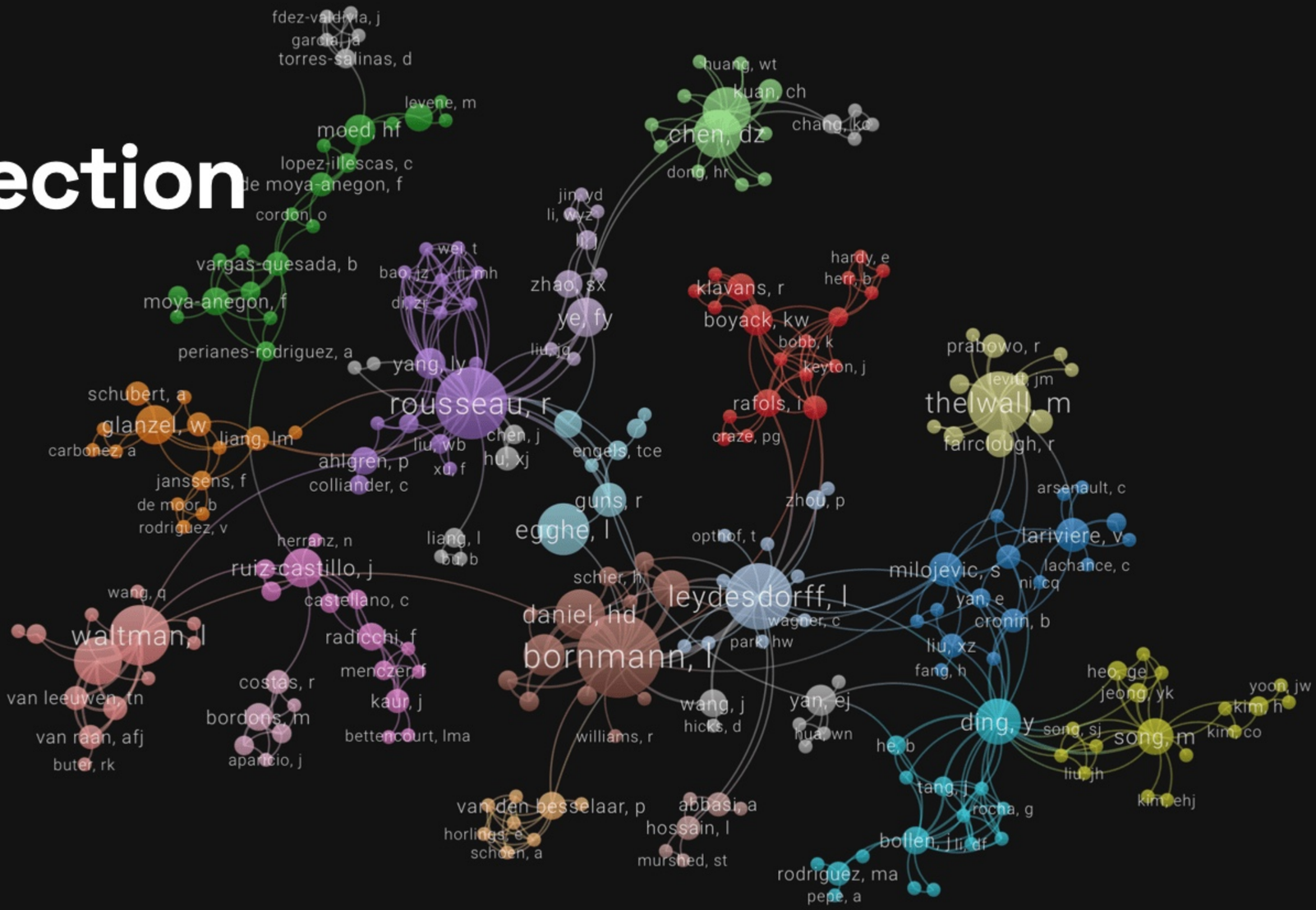


Algorithm

Community Detection

Leiden algorithm

Louvain algorithm



Algorithm

Centrality

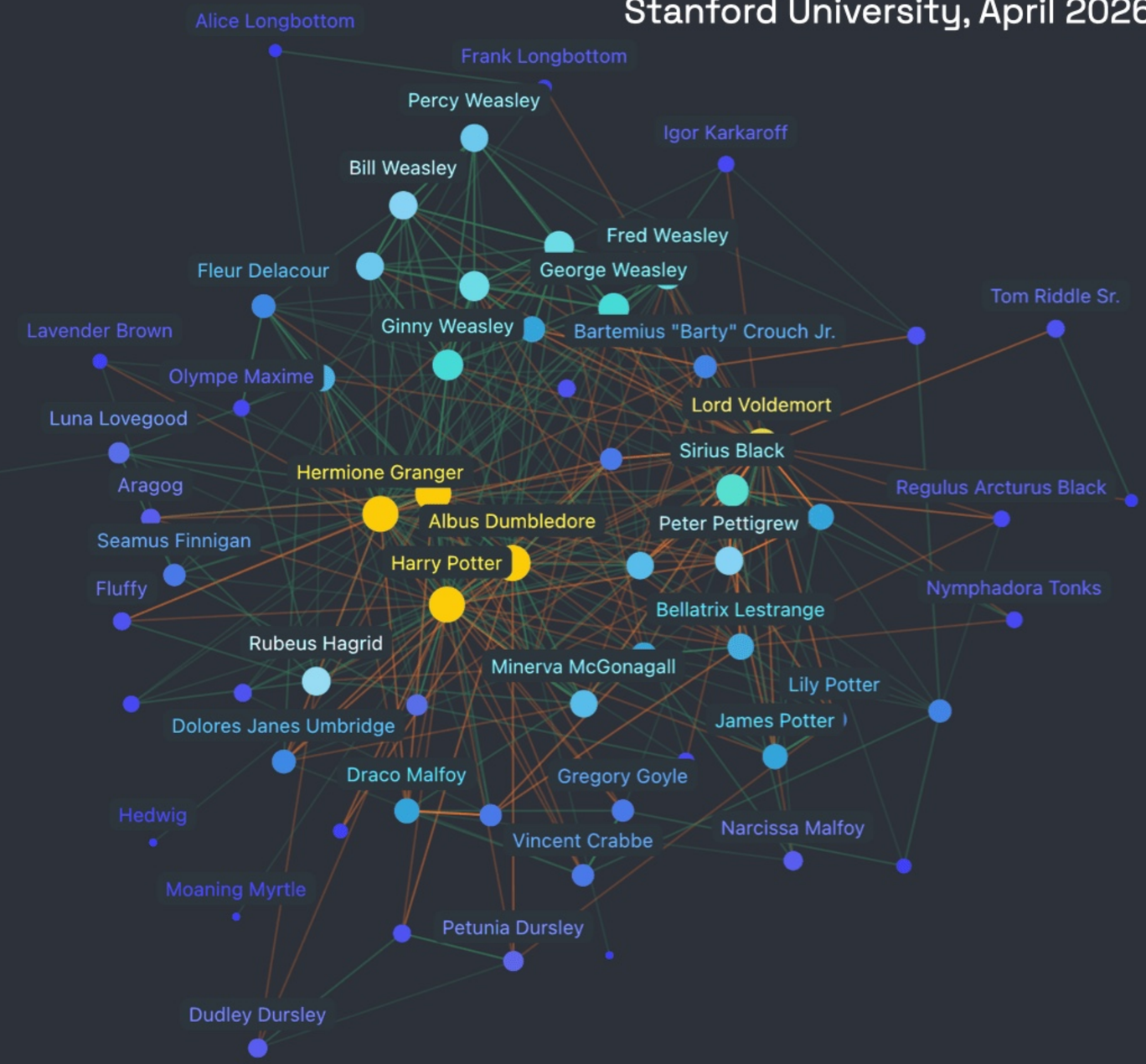
In Degree and Out Degree

Betweenness Centrality

Eigenvector Centrality

Page Rank

...



Algorithm

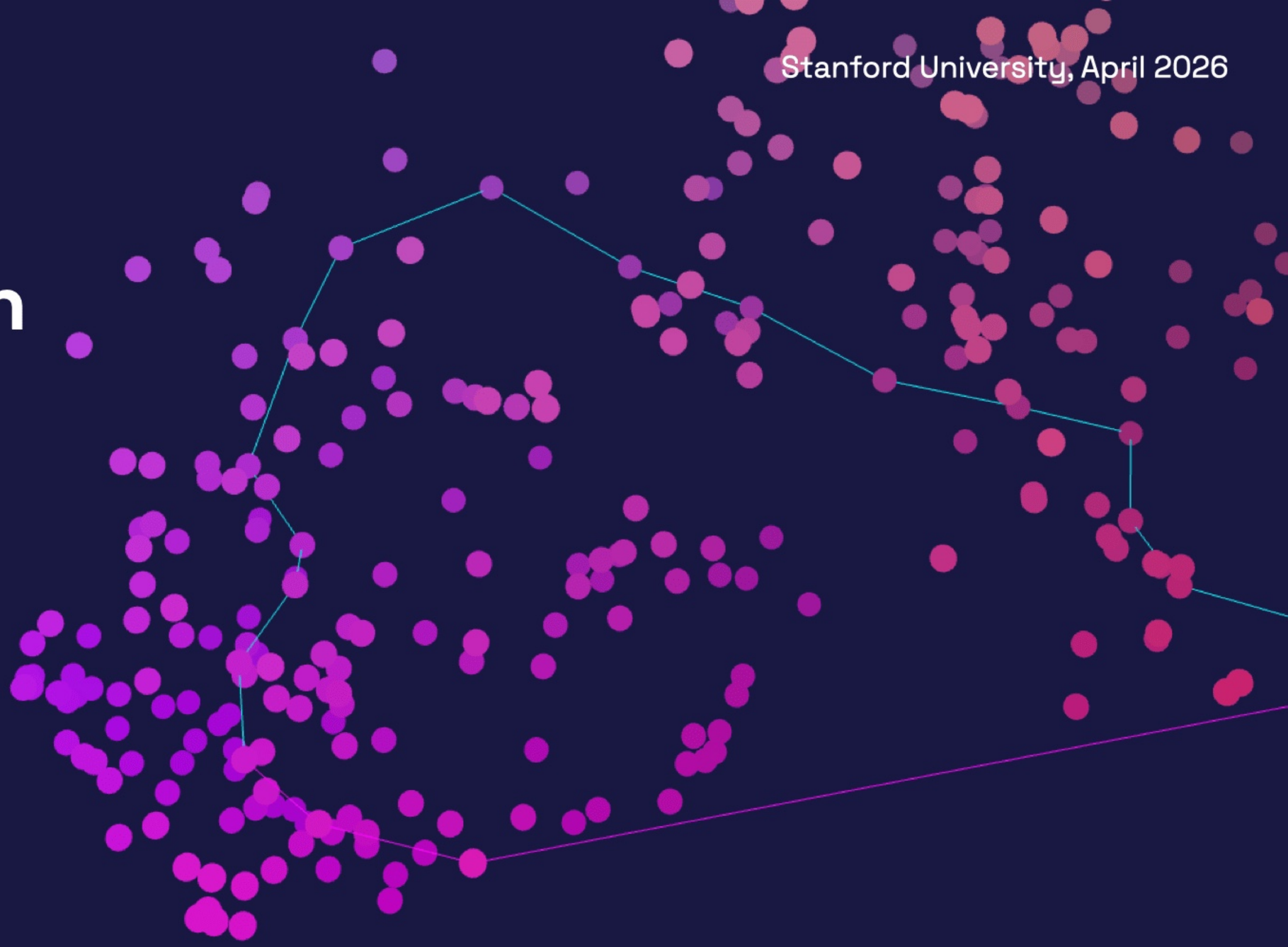
Shortest Path

BFS

Djikstra

Bellman–Ford

...



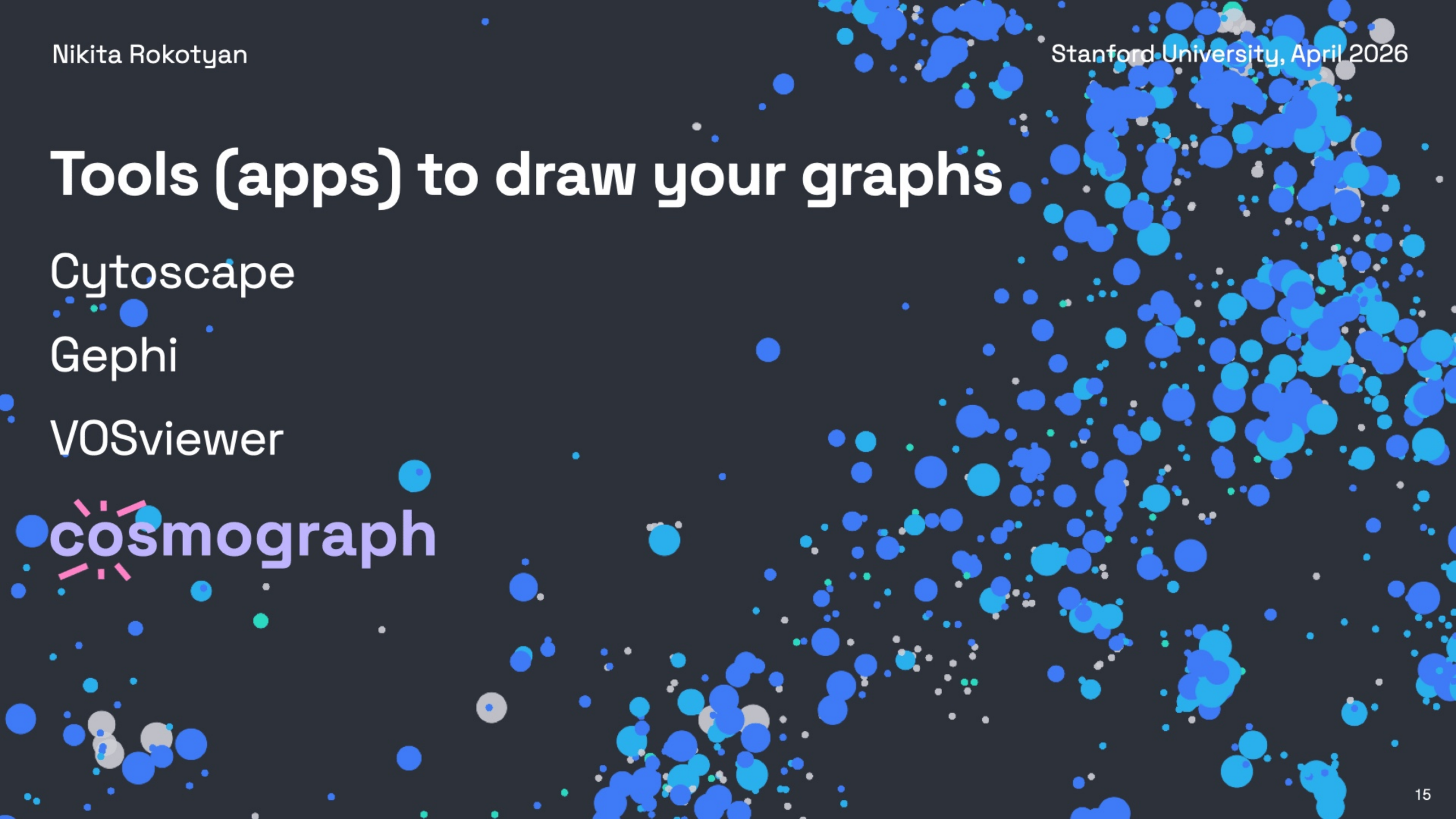
Tools (apps) to draw your graphs

Cytoscape

Gephi

VOSviewer

cosmograph



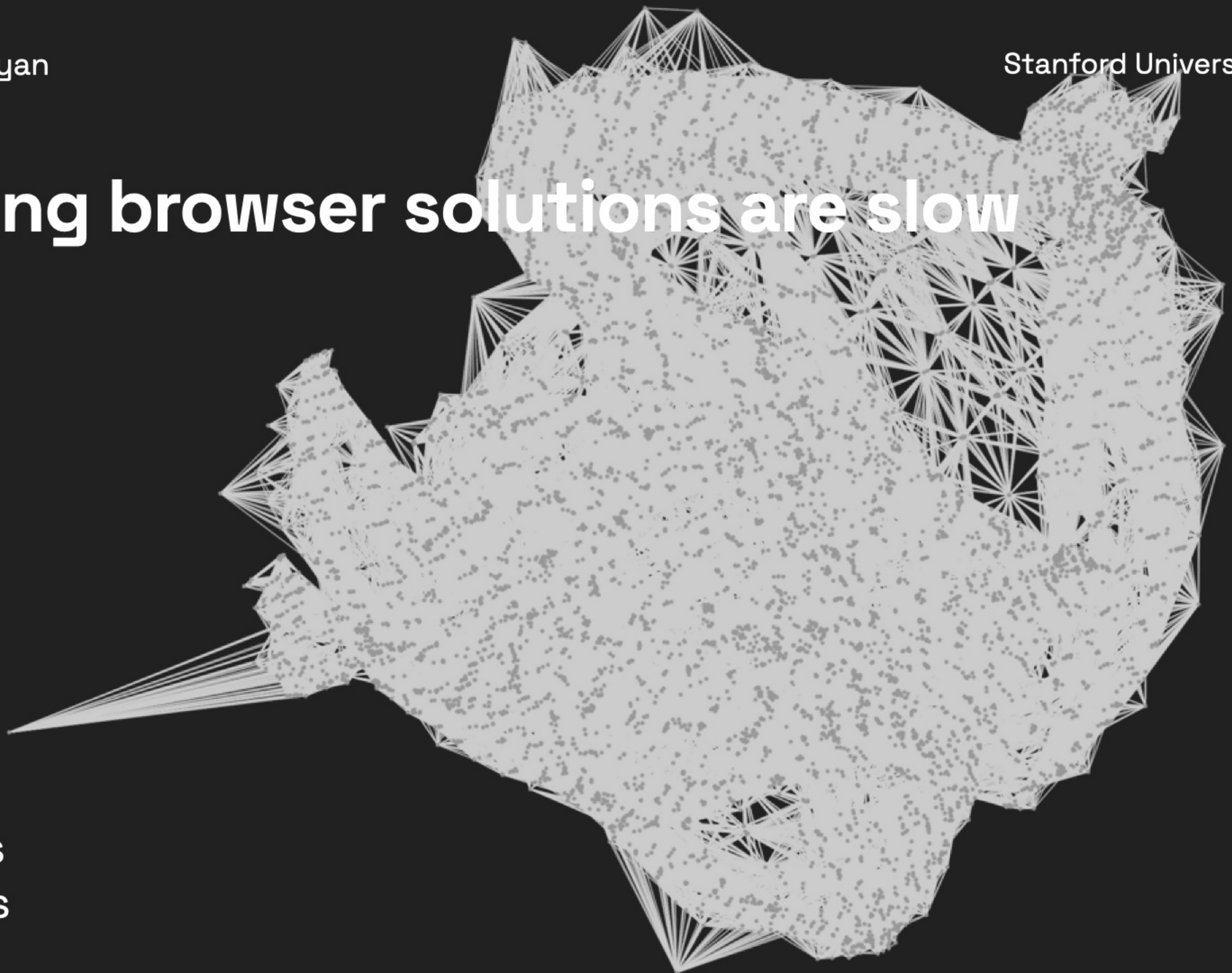
Cosmograph

A library and a web tool for dealing with large graph datasets

cosmograph.app

DuckDB mosaic SQLRooms

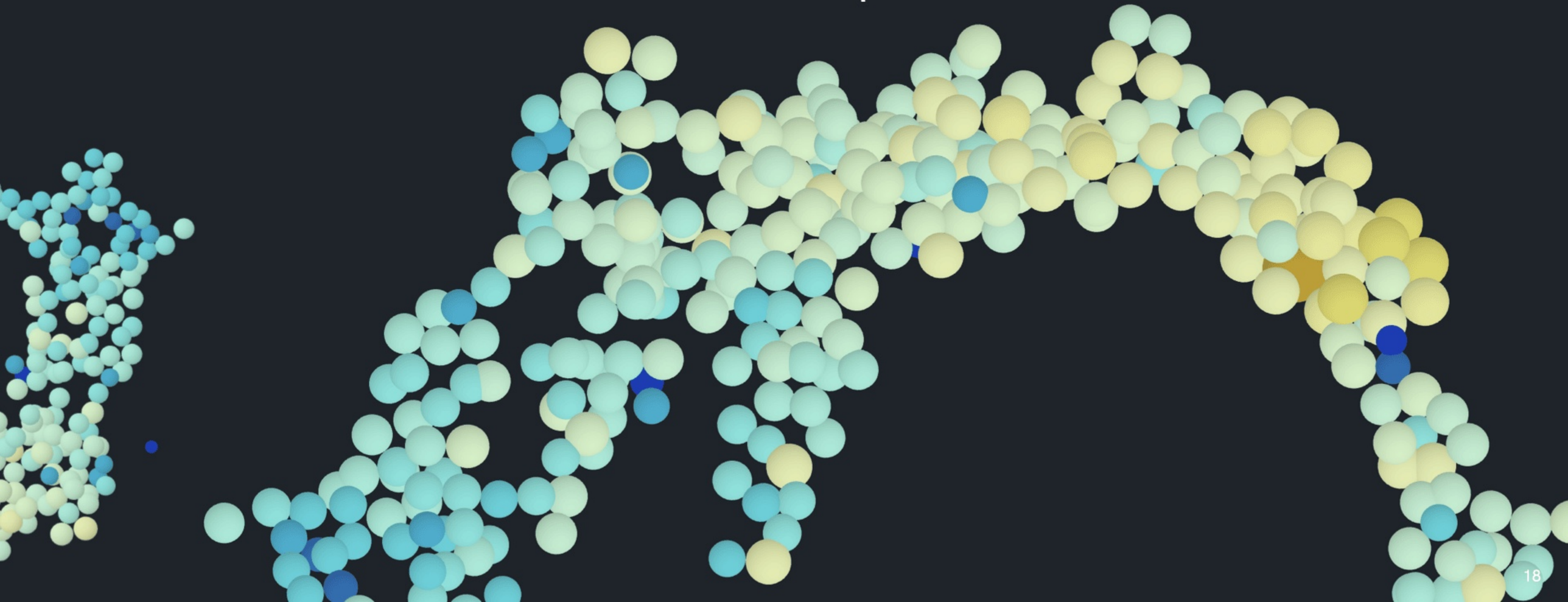
Existing browser solutions are slow



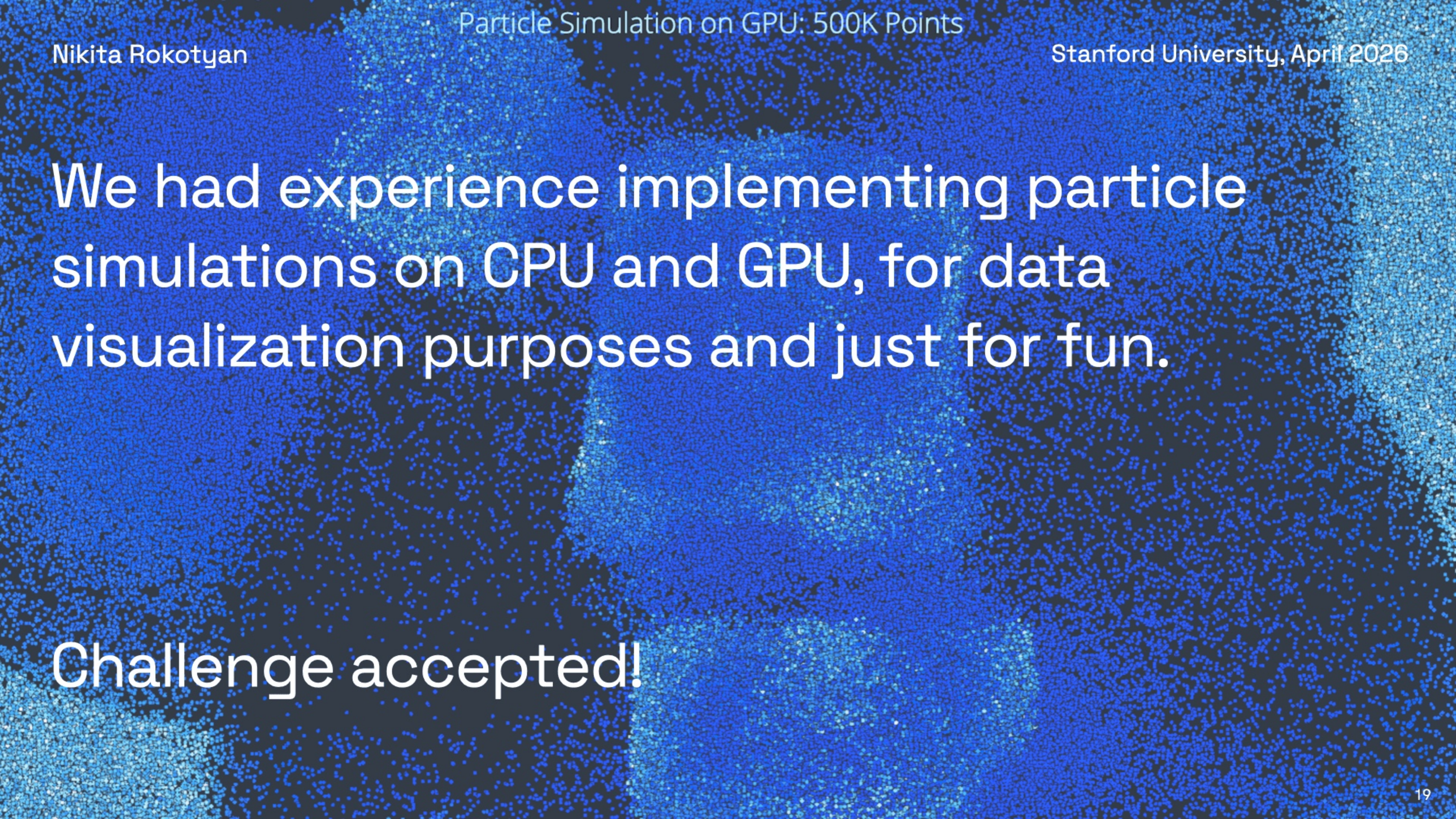
sigma.js
7K points
166K links

Key Problems: Layout & Rendering

Force simulations on GPU are hard to implement

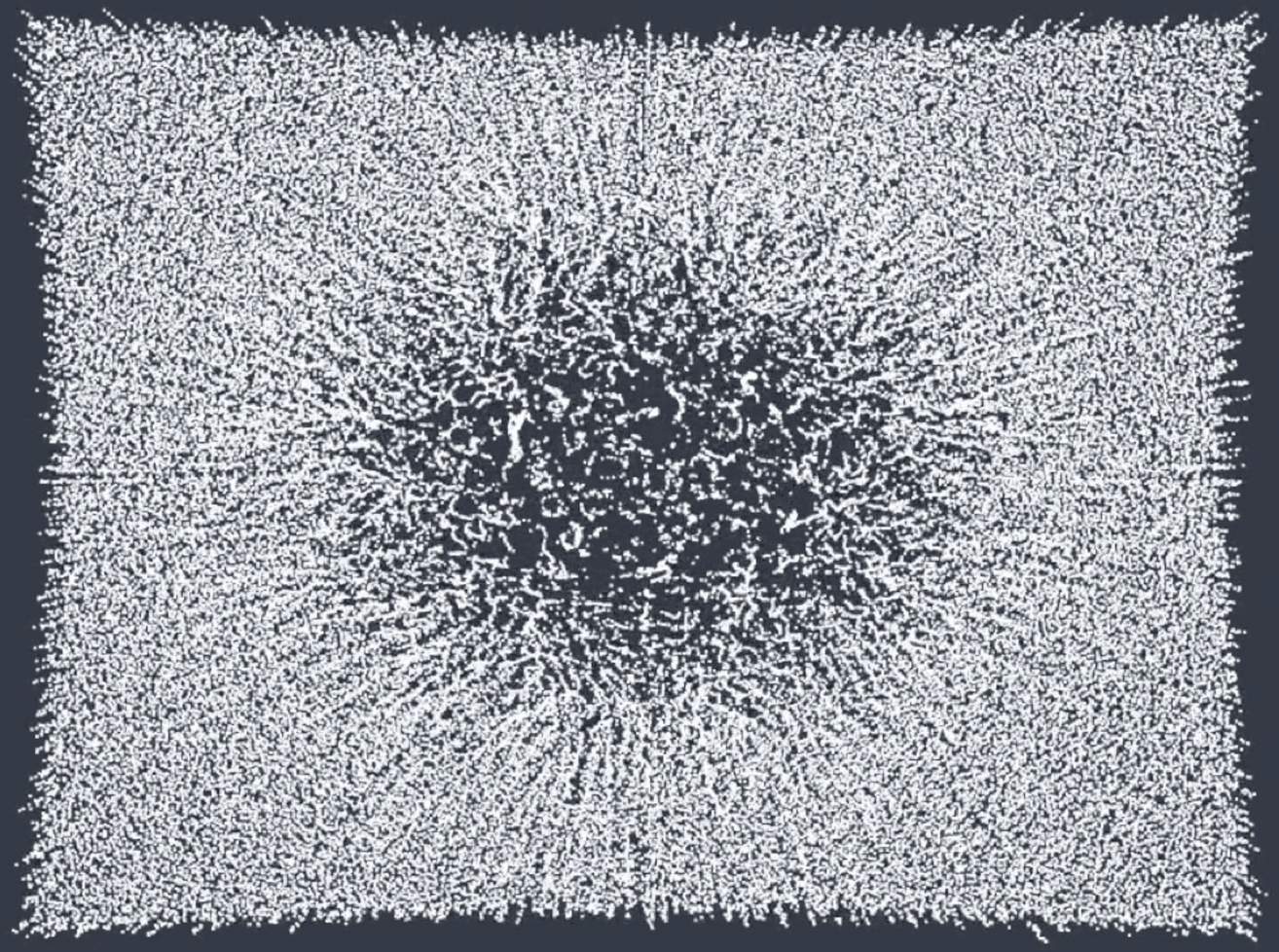


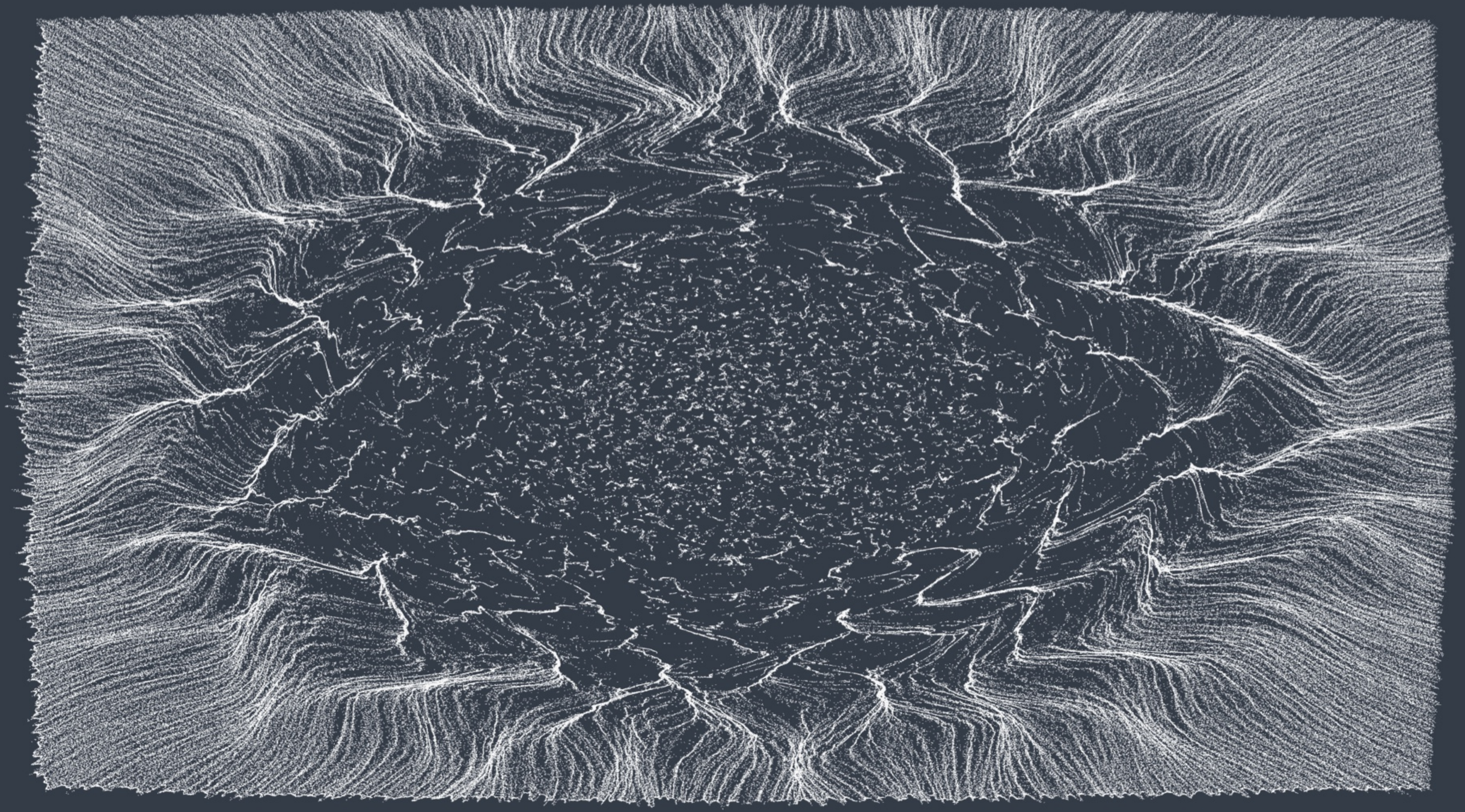
Nikita Rokotyan



We had experience implementing particle simulations on CPU and GPU, for data visualization purposes and just for fun.

Challenge accepted!





Simulation Forces

Many Body

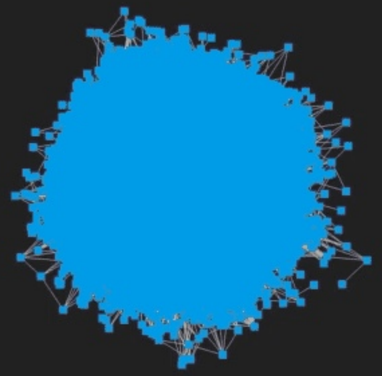
Link

Gravity

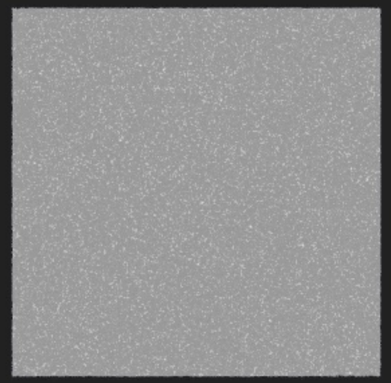
Clustering

Centering

Vivagraph

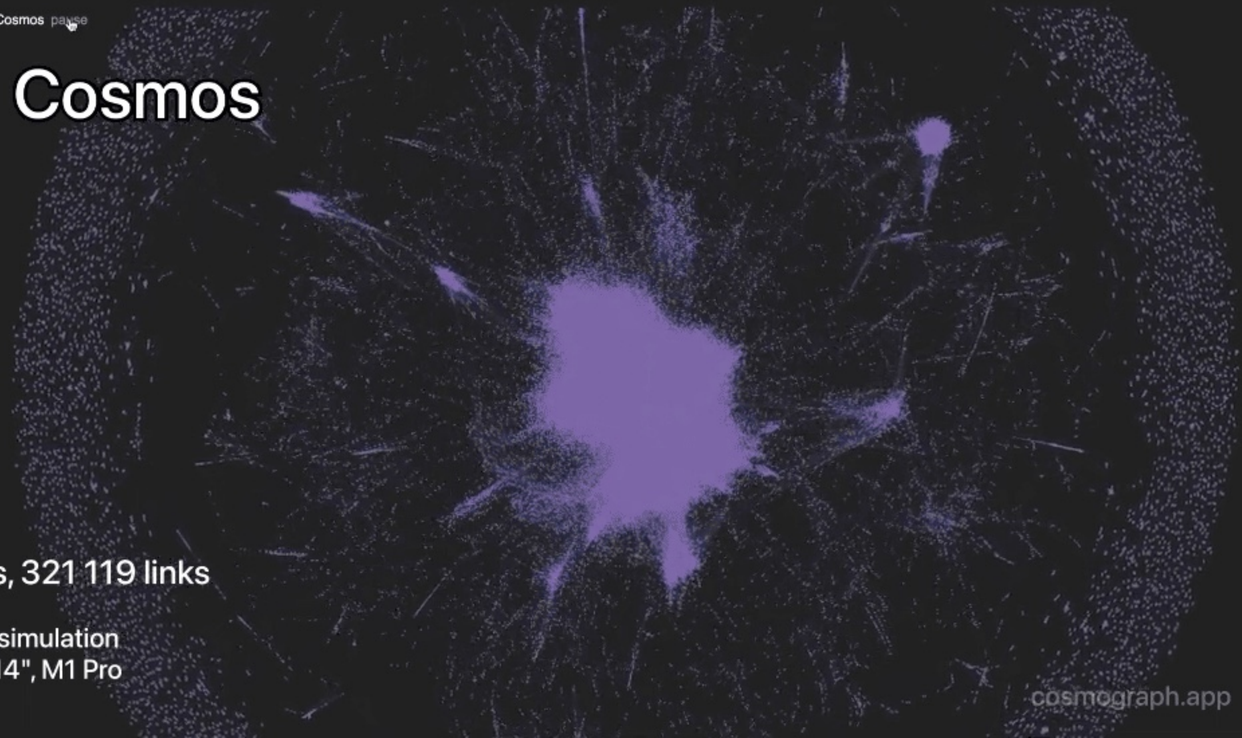


Sigma



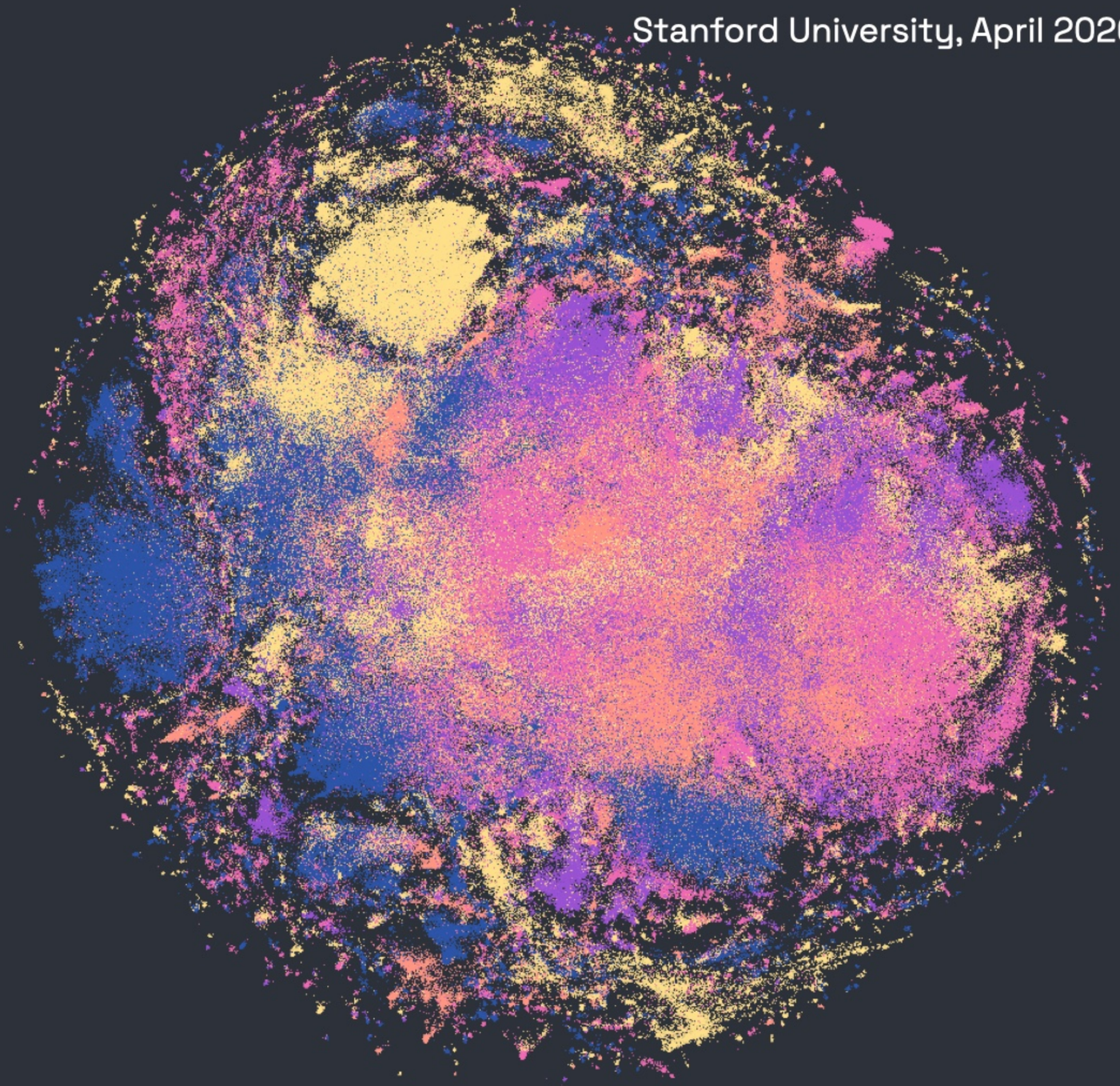
React-force-graph

Cosmos



Cosmograph is also an excellent point rendering engine when you need to visualize ML embeddings at scale

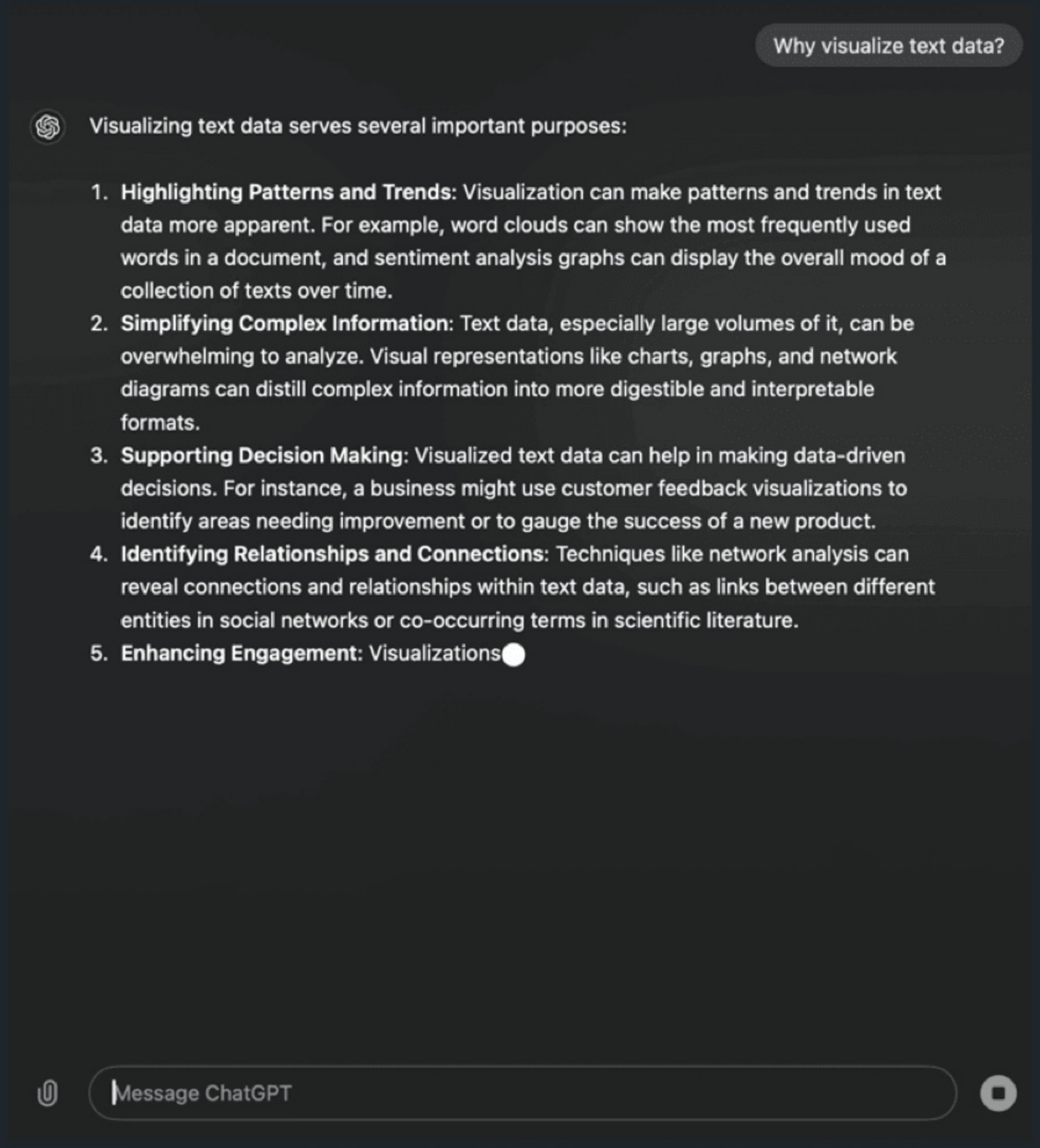
II. Visualizing Text



Why to visualize text?

In just a few years, language models have become deeply integrated into our lives and have opened up new possibilities for working with text.

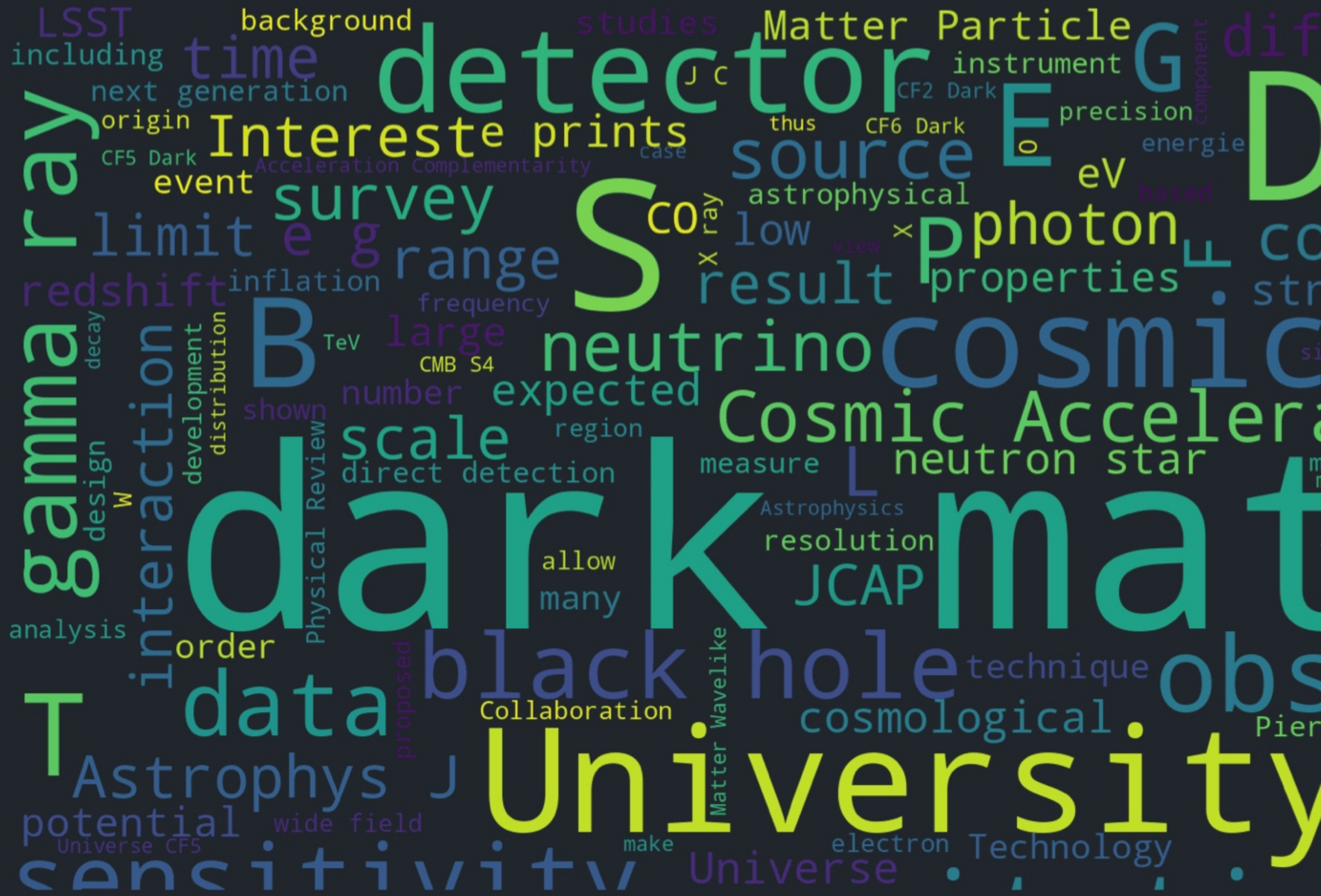
We generate unprecedented amounts of textual data every day.



Word Clouds

1990s

Probably the most popular and simple way to visualize text

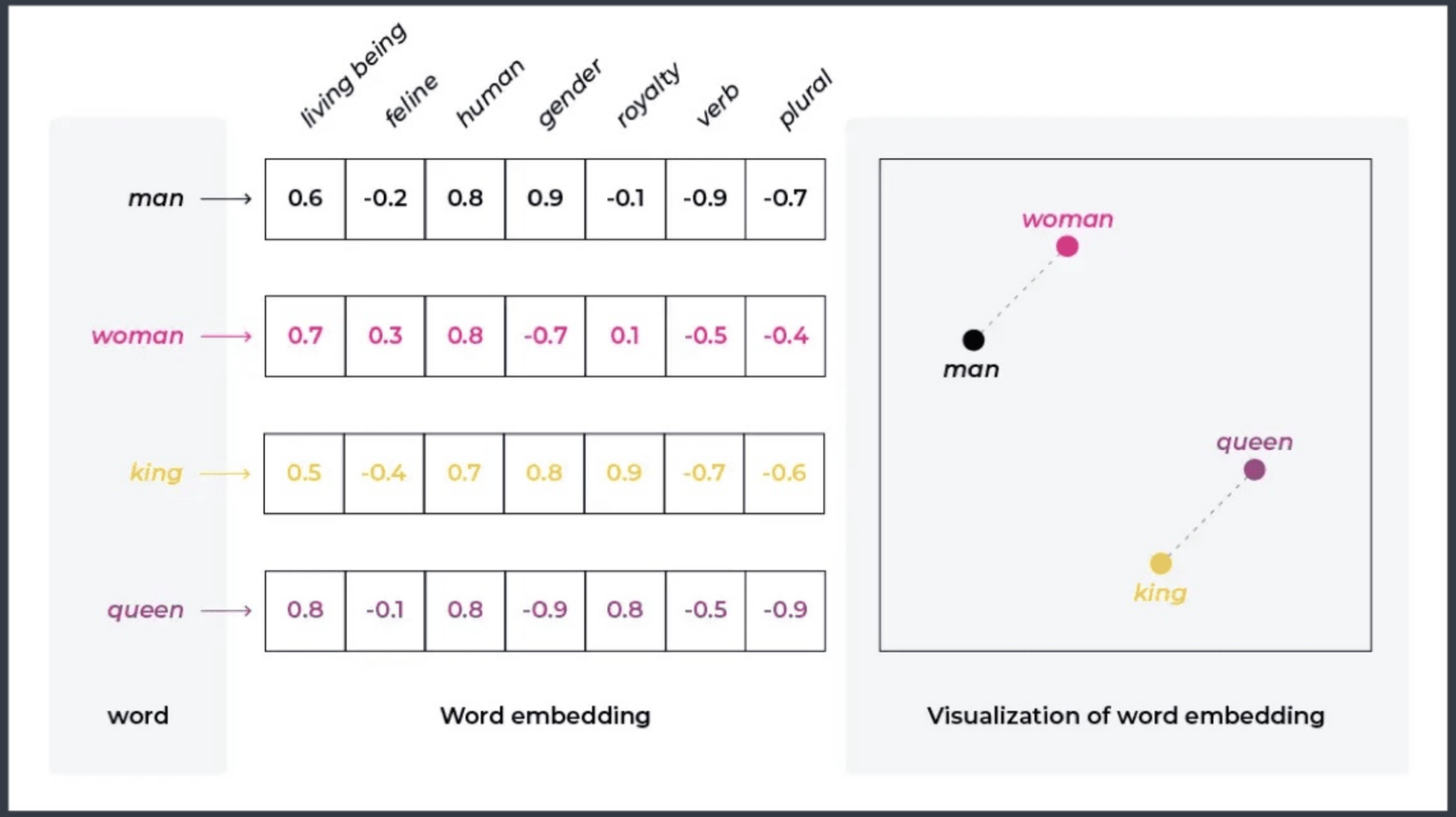


A Little Bit of History

1930s	Zipf's law
1950s	Term Frequency (TF)
1970s	TF-IDF, Vector Space, N-grams
1980-1990s	Latent Semantic Analysis, Decision Trees, Support Vector Machines, and Bayesian Classifiers
2000s	Probabilistic models such as Latent Dirichlet Allocation
2010 - now	Recurrent Neural Networks (RNNs), Long Short-Term Memory (LSTM) networks, Transformer Models (such as BERT and GPT)

Text Embeddings

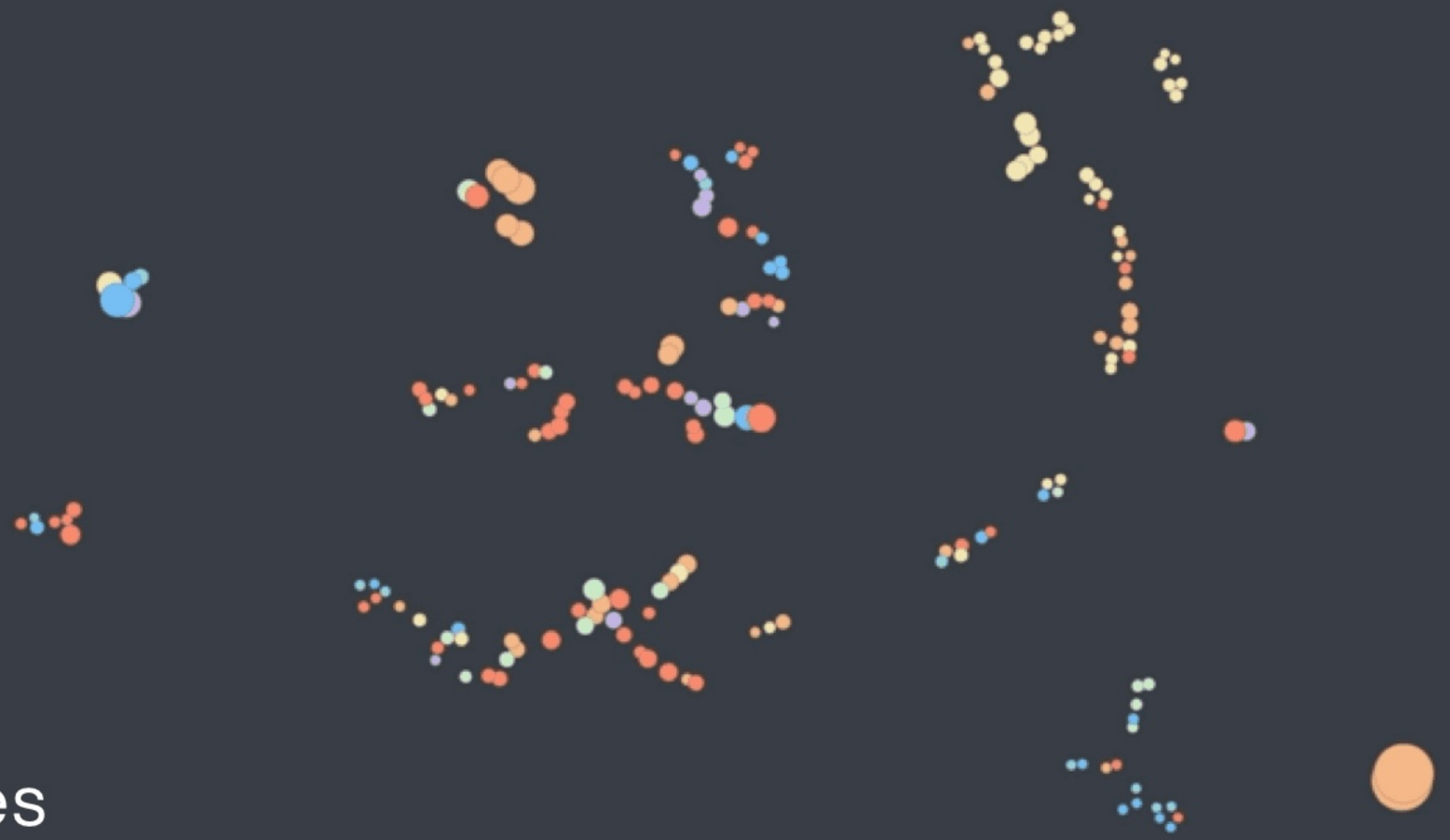
Represent words or phrases in a dense, low-dimensional vector space, capturing semantic relationships between words.



But how to turn thousands of numbers into a map?

🤔

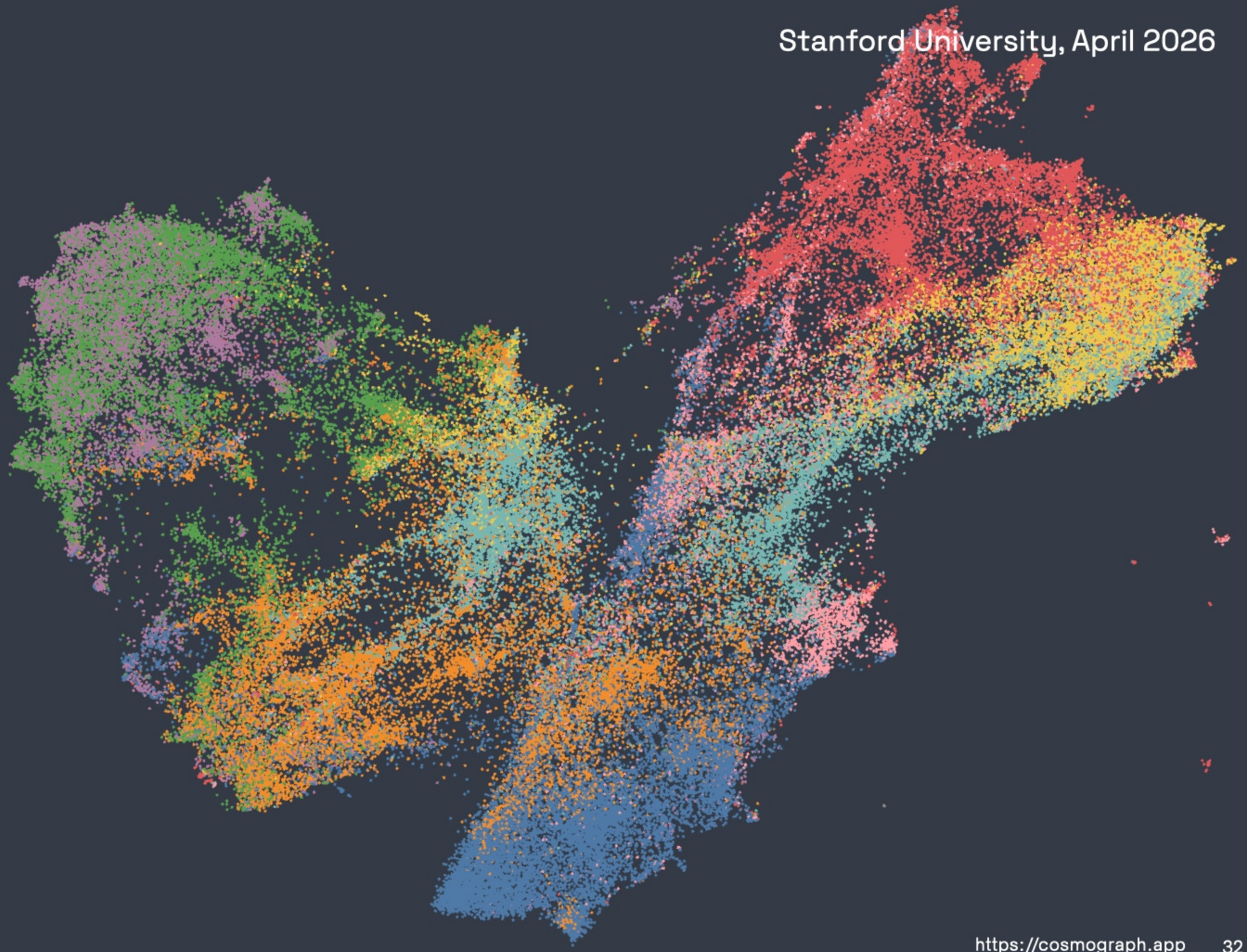
PCA, t-SNE, UMAP, ...



Dimensionality Reduction Techniques come to the rescue

https://interacta.io/projects/country-tsne

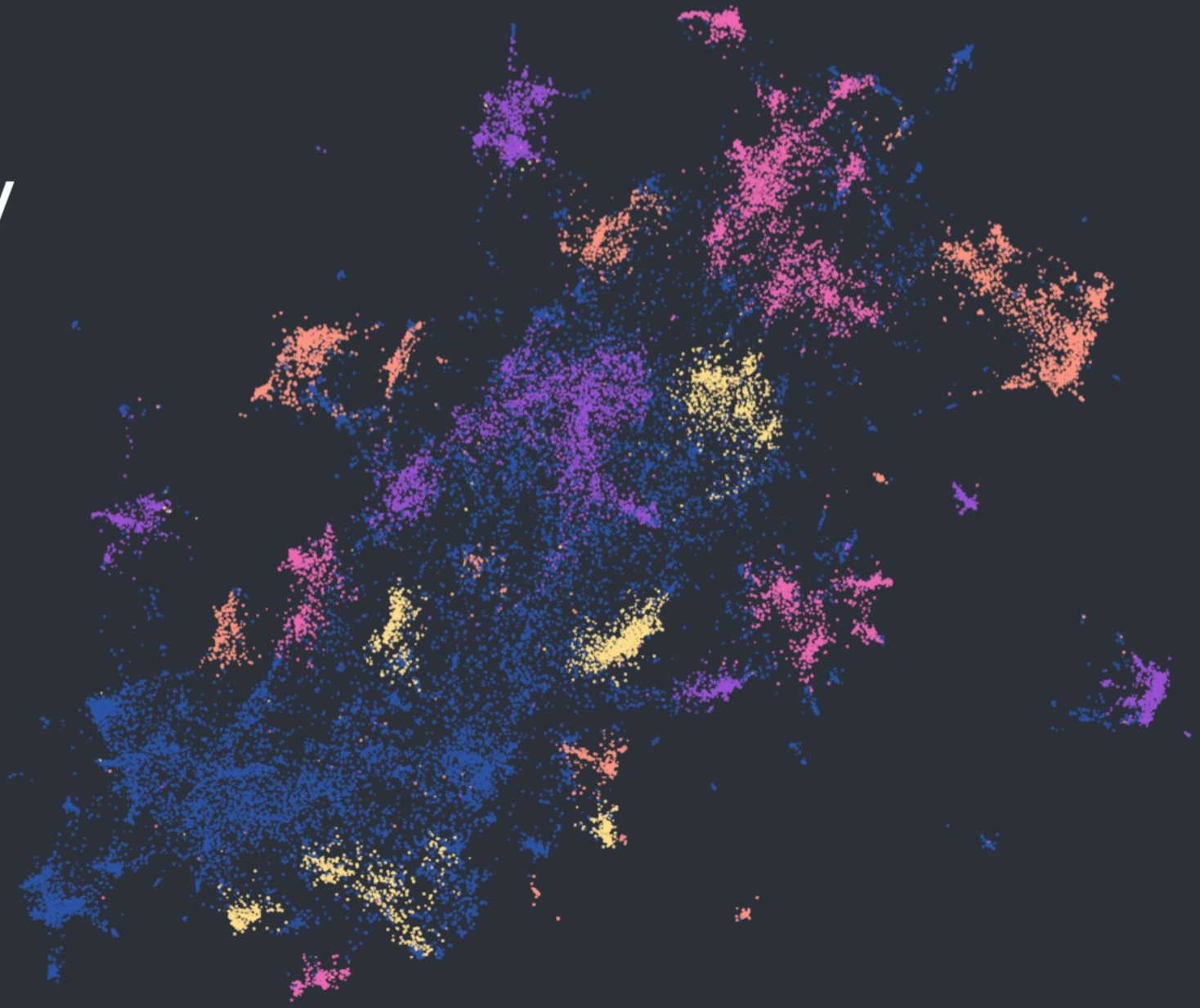
On a Large Scale



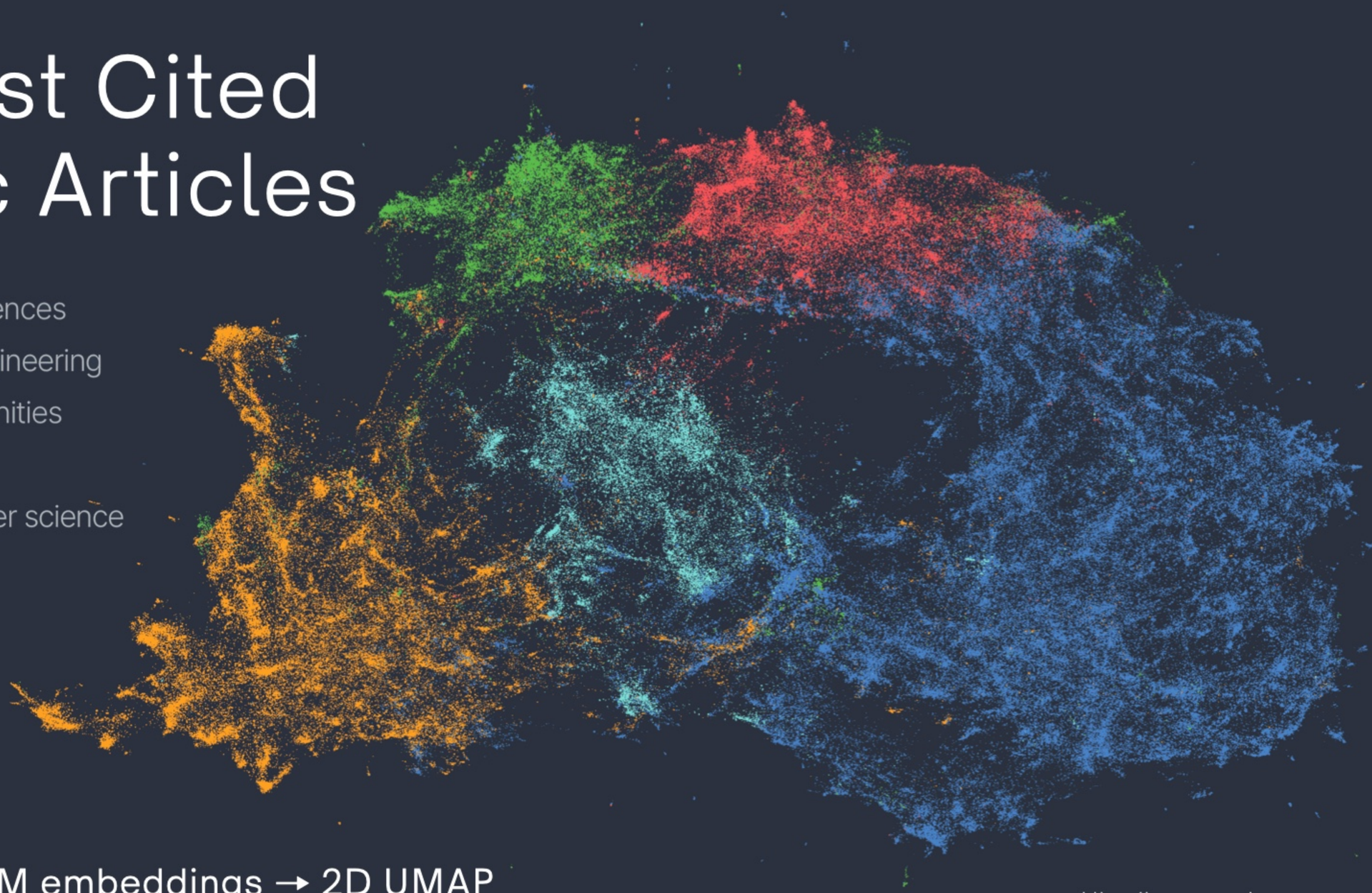
You get beautiful semantic maps of your texts

You can also apply a variety of algorithms to your embeddings

HDBScan, K-Means, Vector Search, Topic Modeling, ...



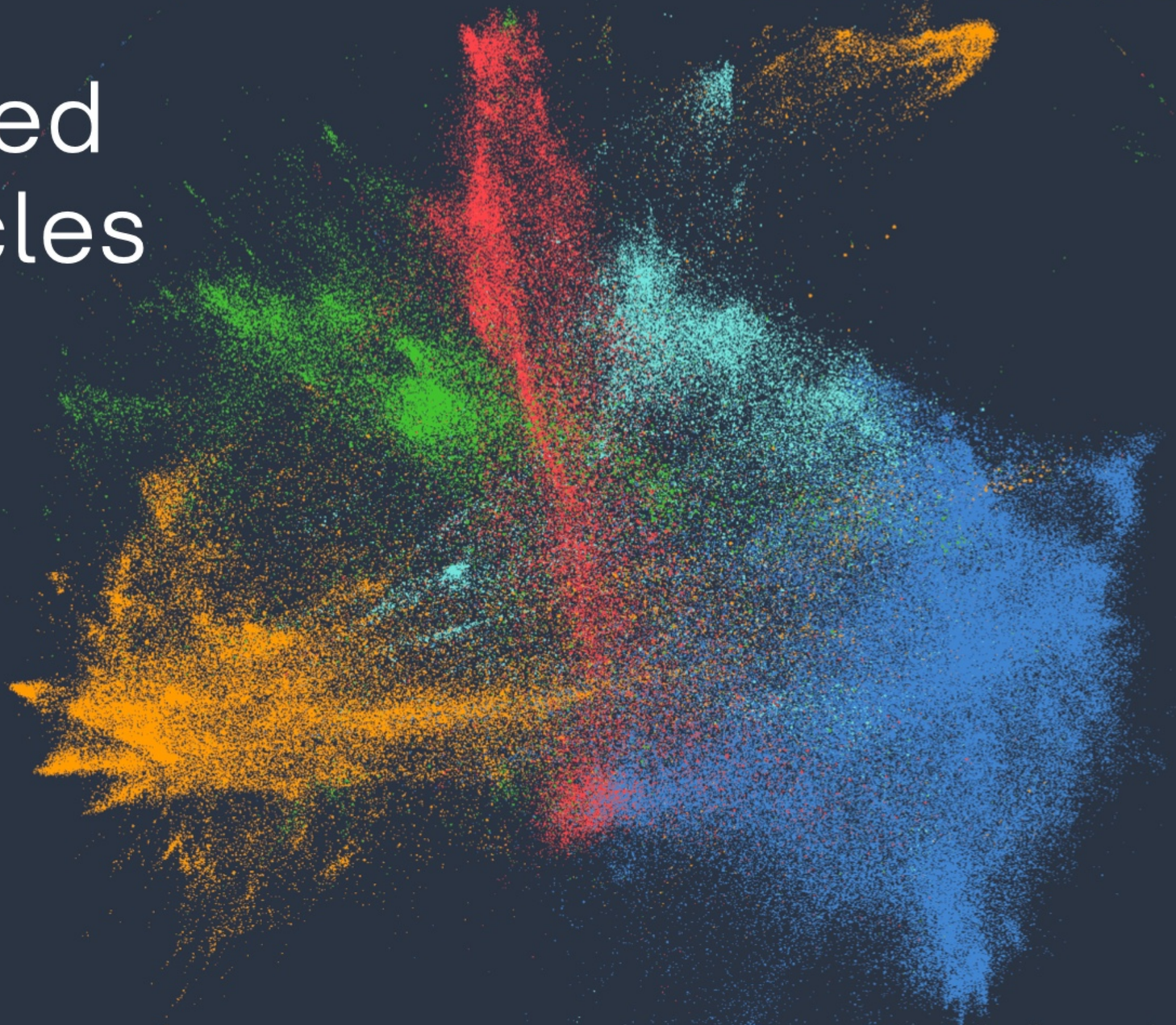
350K Most Cited Scientific Articles



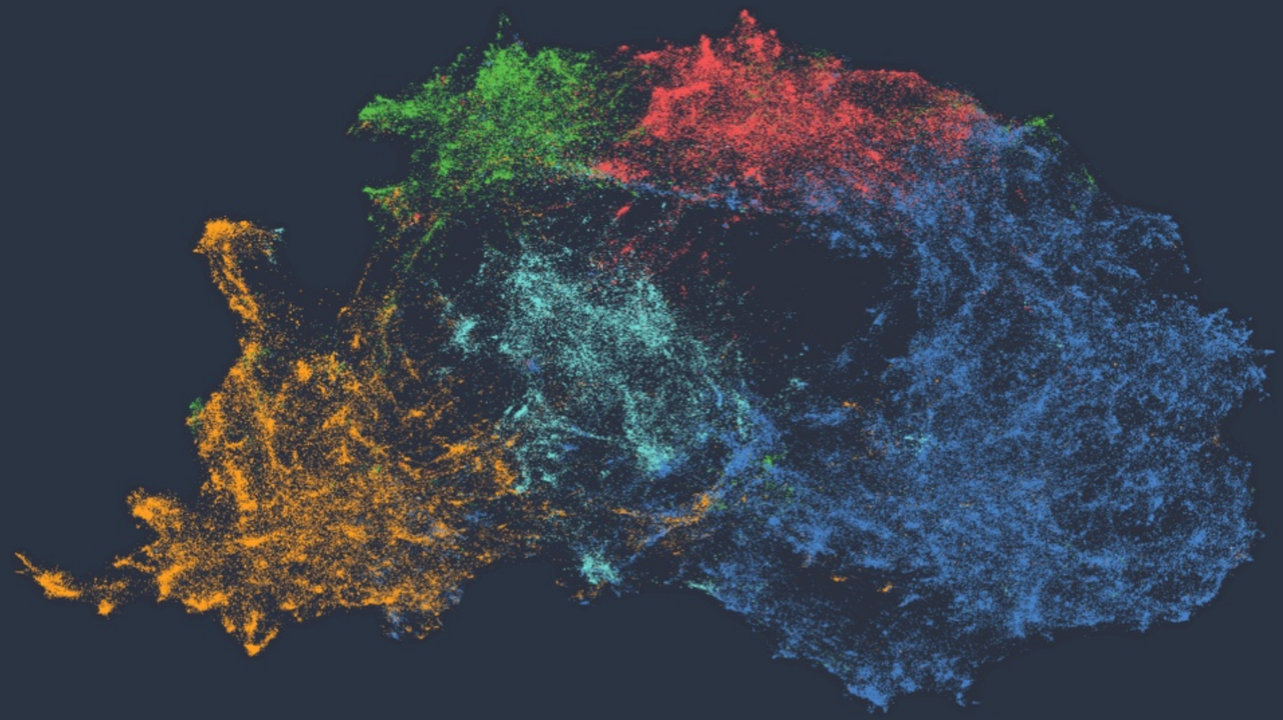
* Paper abstracts → LLM embeddings → 2D UMAP

350K Most Cited Scientific Articles

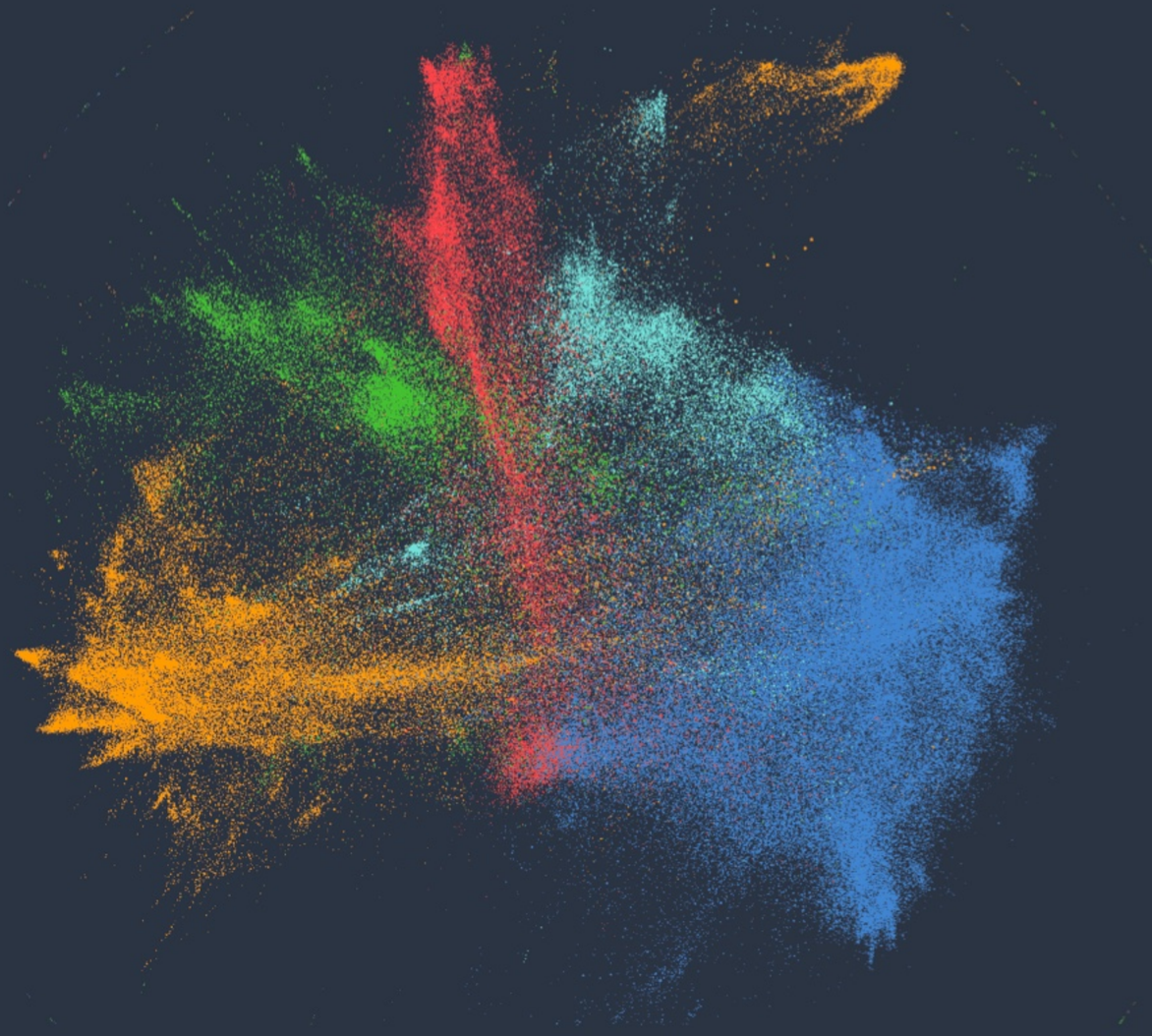
- Biomedical and health sciences
- Physical sciences and engineering
- Social sciences and humanities
- Life and earth sciences
- Mathematics and computer science



* Same dataset visualized using the force-directed graph layout



Semantic



Network Graph

But how to do all this data prep?!

Vibe code it!

Update Build source dependency graph claude-code ···

I have this repository. How can I build a dependency graph of it's source code

13 previous messages

I added a repo-local scanner at scripts/build-dependency-graph.mjs.

This repo looks like a TypeScript source dump without the usual `package.json` / `tsconfig`, so the most reliable path here is static import analysis rather than trying to force `madge` / `dependency-cruiser` onto it. The script scans `import`, `export ... from`, `require()`, resolves this codebase's relative `.js` imports back to `.ts` / `.tsx`, and emits `mermaid`, `dot`, or `json`.

bash

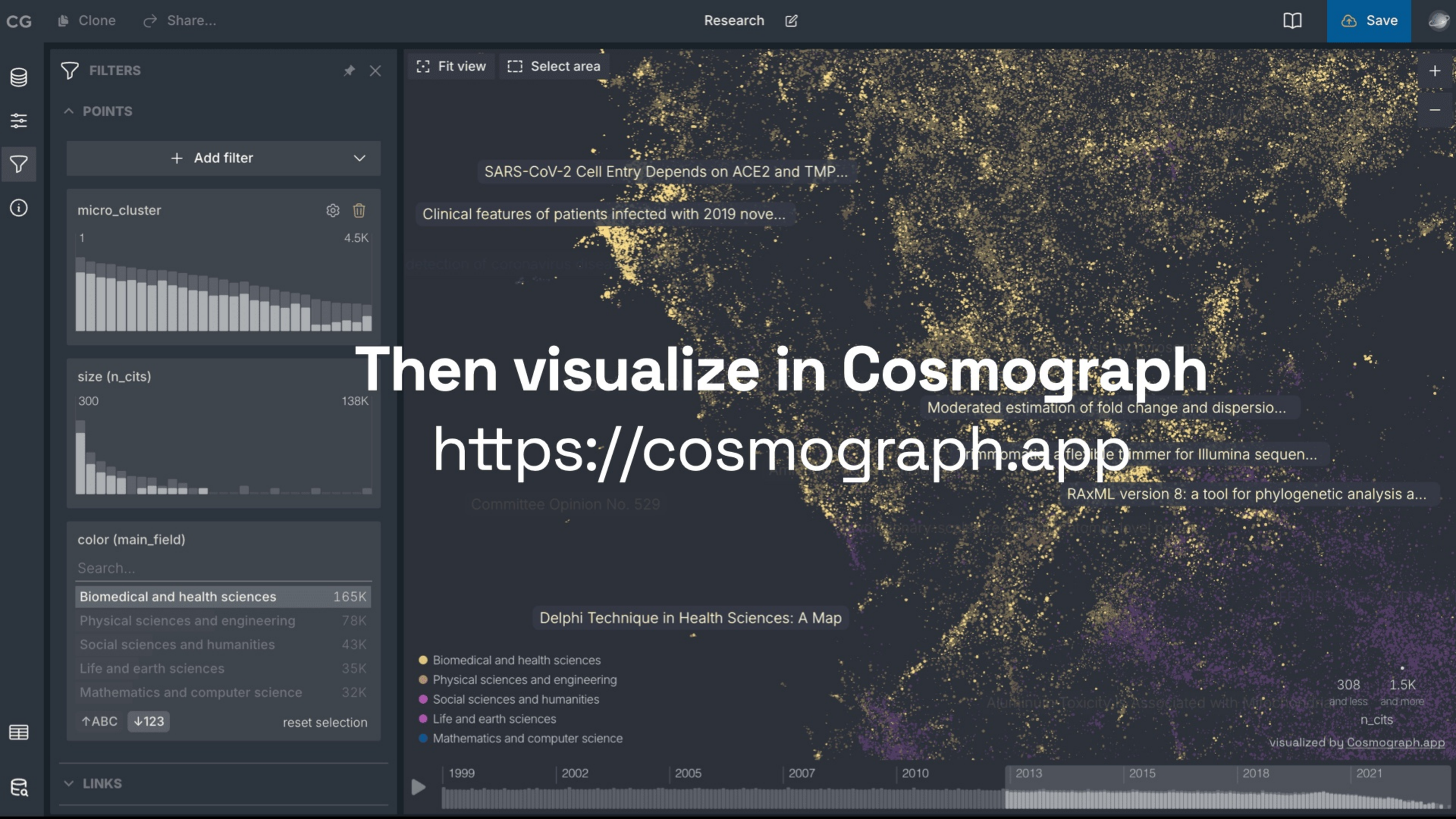
```
cd /Users/nikitarokotyan/Downloads/claude-code

# Whole repo, top-level folders
node scripts/build-dependency-graph.mjs > dep-graph.mmd

# Better first zoom: services split to depth 2
node scripts/build-dependency-graph.mjs --scope services --depth 2 > services.mmd

# File-level slice for one subsystem
node scripts/build-dependency-graph.mjs --scope services/mcp --granularity file > services-m

# Machine-readable or Graphviz-friendly output
node scripts/build-dependency-graph.mjs --format json > dep-graph.json
node scripts/build-dependency-graph.mjs --fo t dot > dep-graph.dot
```


CG
Clone
Share...
Research
Save
FILTERS
POINTS
Add filter
micro_cluster
1
4.5K
size (n_cits)
300
138K
color (main_field)
Search...
Biomedical and health sciences 165K
Physical sciences and engineering 78K
Social sciences and humanities 43K
Life and earth sciences 35K
Mathematics and computer science 32K
↑ABC
↓123
reset selection
LINKS
Fit view
Select area
SARS-CoV-2 Cell Entry Depends on ACE2 and TMP...
Clinical features of patients infected with 2019 nove...
Then visualize in Cosmograph
https://cosmograph.app
Moderated estimation of fold change and dispersio...
RAxML version 8: a tool for phylogenetic analysis a...
Committee Opinion No. 529
Delphi Technique in Health Sciences: A Map
Biomedical and health sciences
Physical sciences and engineering
Social sciences and humanities
Life and earth sciences
Mathematics and computer science
308
and less
1.5K
and more
n_cits
visualized by Cosmograph.app
1999
2002
2005
2007
2010
2013
2015
2018
2021

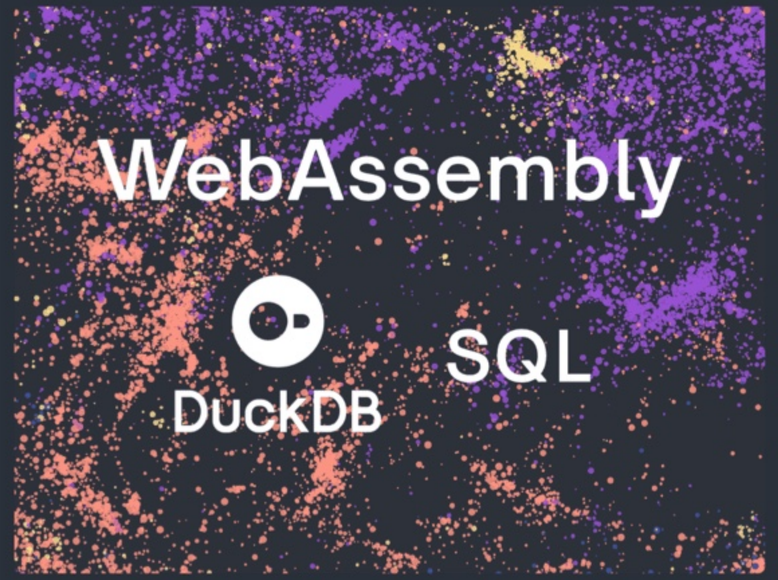
```
graph = cosmo(
  points=points,
  links=links,
  point_id_by='id',
  point_color_by='label',
  point_size_by='value',
  point_label_by='label',
  disable_point_size_legend=True,
  link_source_by='source',
  link_target_by='target',
  point_timeline_by='date'
)
graph
```

By the way, there's a Python widget

$ pip install cosmograph

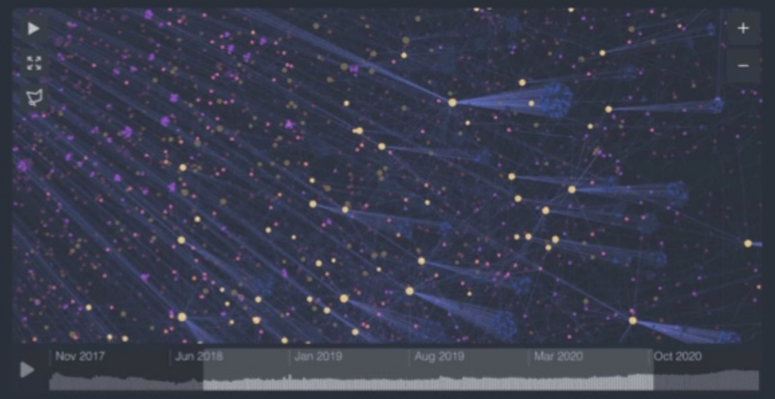
GPU Force Layout and ultra-fast rendering

The simulation runs entirely on the device GPU for real-time layout updates, with no CPU bottlenecks! WebGL rendering, zero-copy data flow, multi-million node graphs.



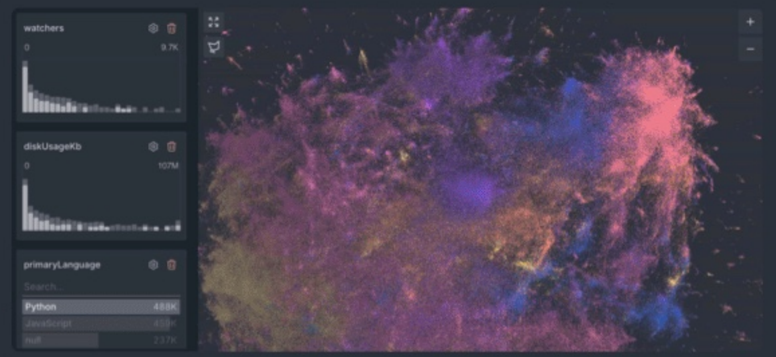
Built-in Analytics Engine

DuckDB-WASM for in-browser SQL on millions of rows.



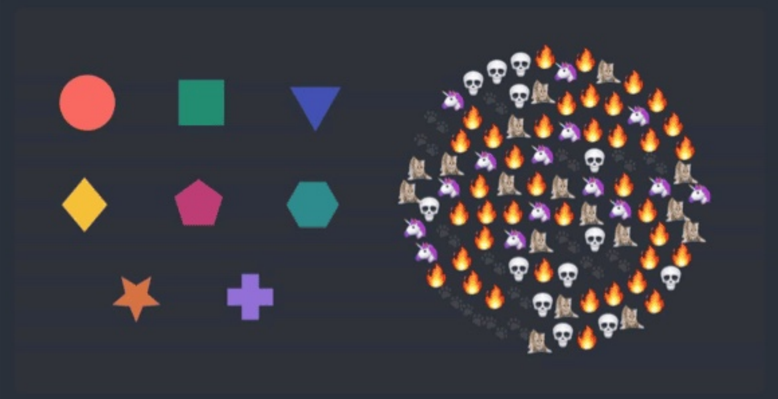
Timeline

Interval-aware timeline for points and links with adaptive binning from ms to years. Linked brushing updates all views instantly.



Filters

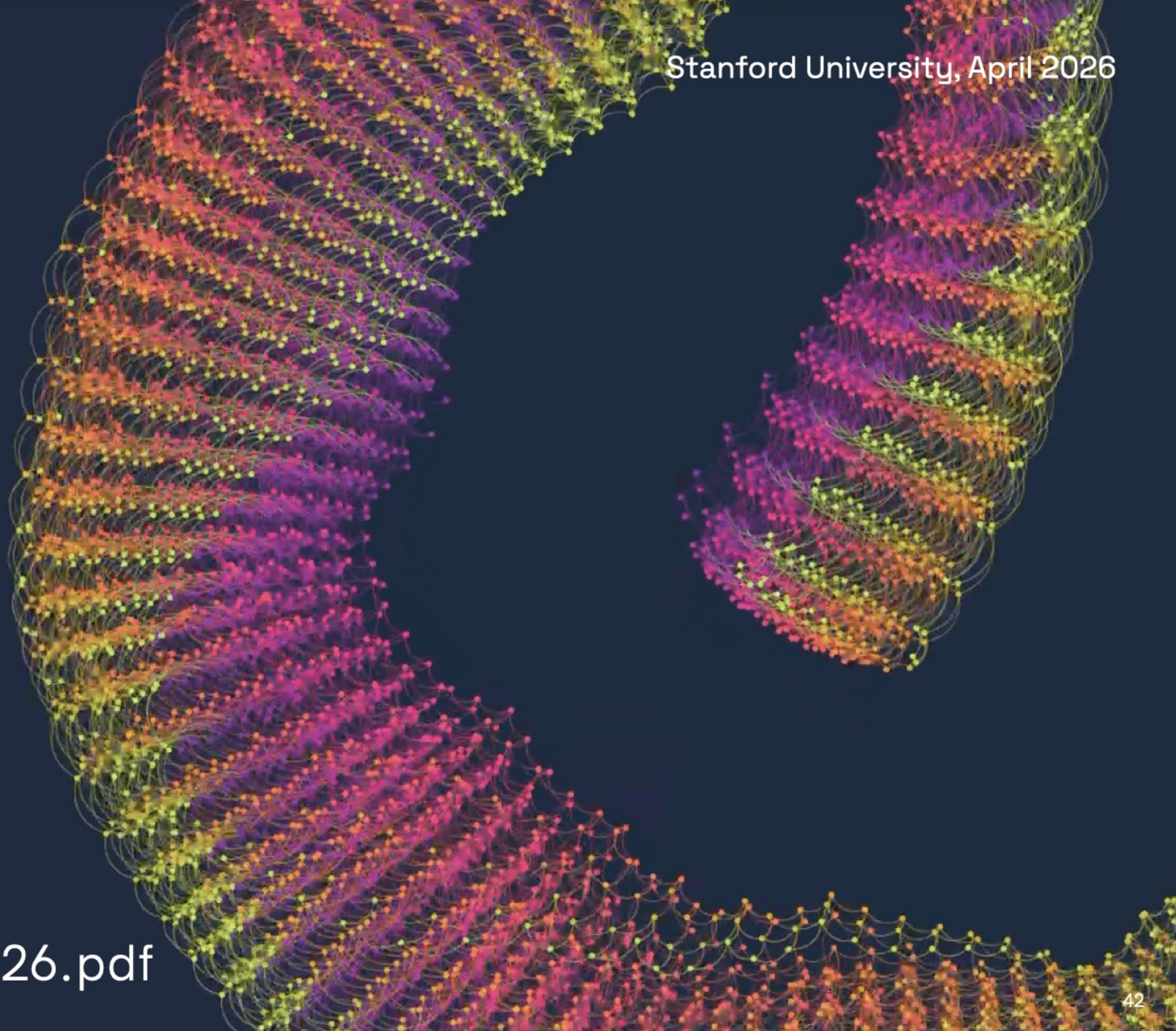
Histograms for numeric, categorical, temporal data with real-time cross-filtering.



Customization

Custom node shapes, images, curved links, data-driven styles, and more.

🙌 Thank you!



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rokotyan.com

https://rokotyan.com/cosmograph-stanford-2026.pdf