

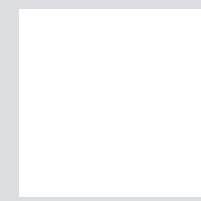
PRIMER INTO DATA VISUALIZATION

AY 119 | SPRING 2026

PRIMER INTO DATA VISUALIZATION

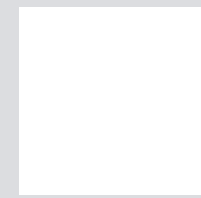
AY 119 | SPRING 2026

ABOUT YOU



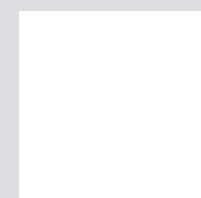
your name

how you want to be called, and how you will submit your work



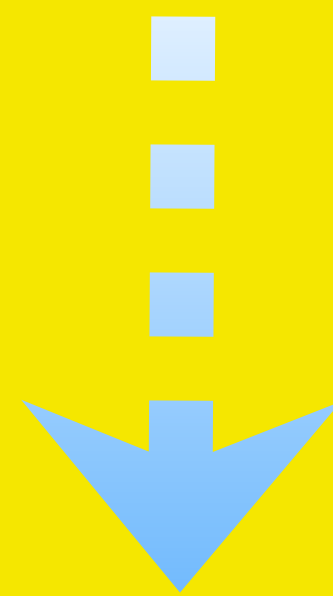
programming experience

python? r? javascript? use of AI? codex? claudecode?



datavis

data? tableau? infographics? p5js? unity? D3?



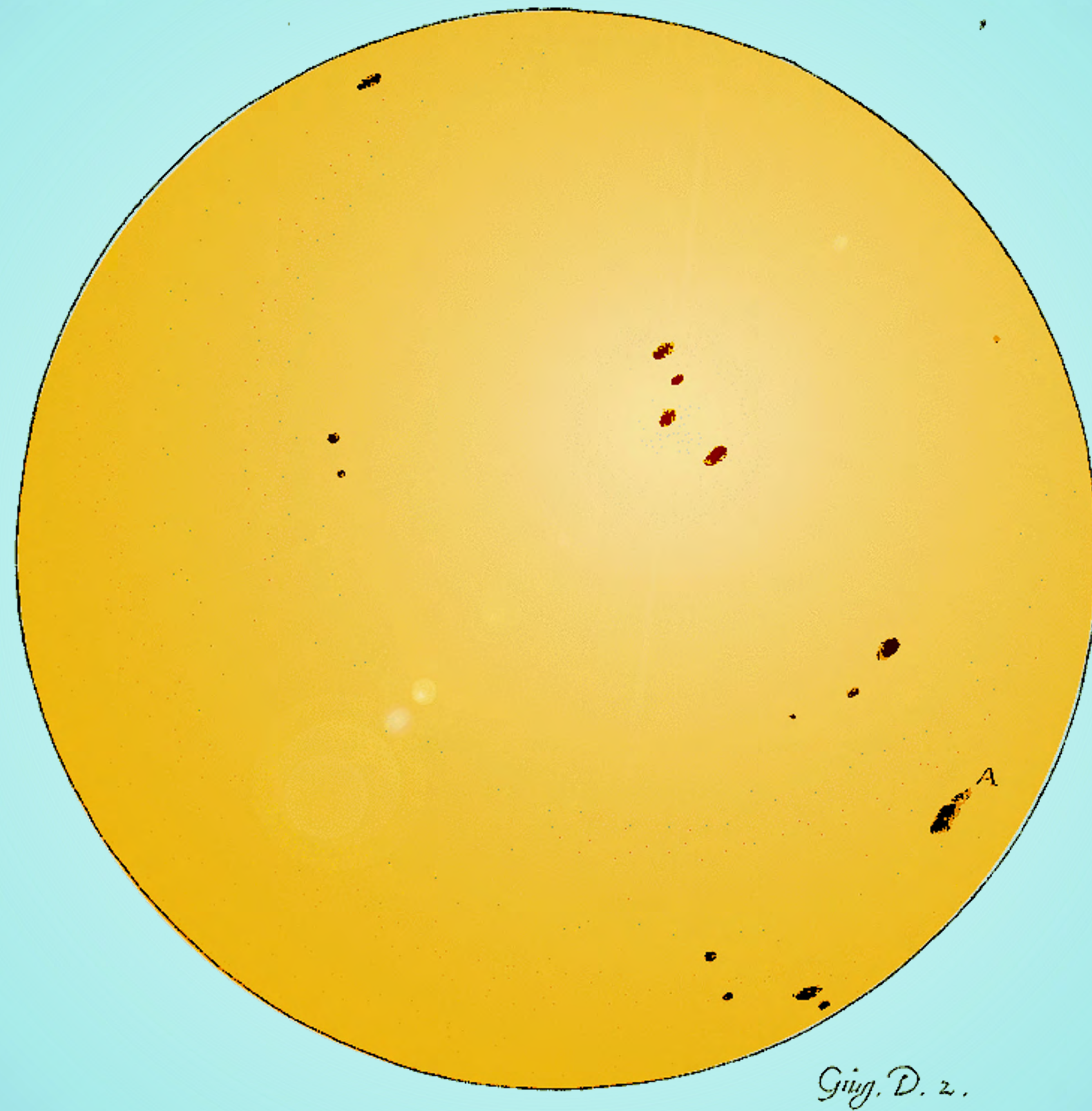
*MORE UNDERSTANDABLE
REPRESENTATION*

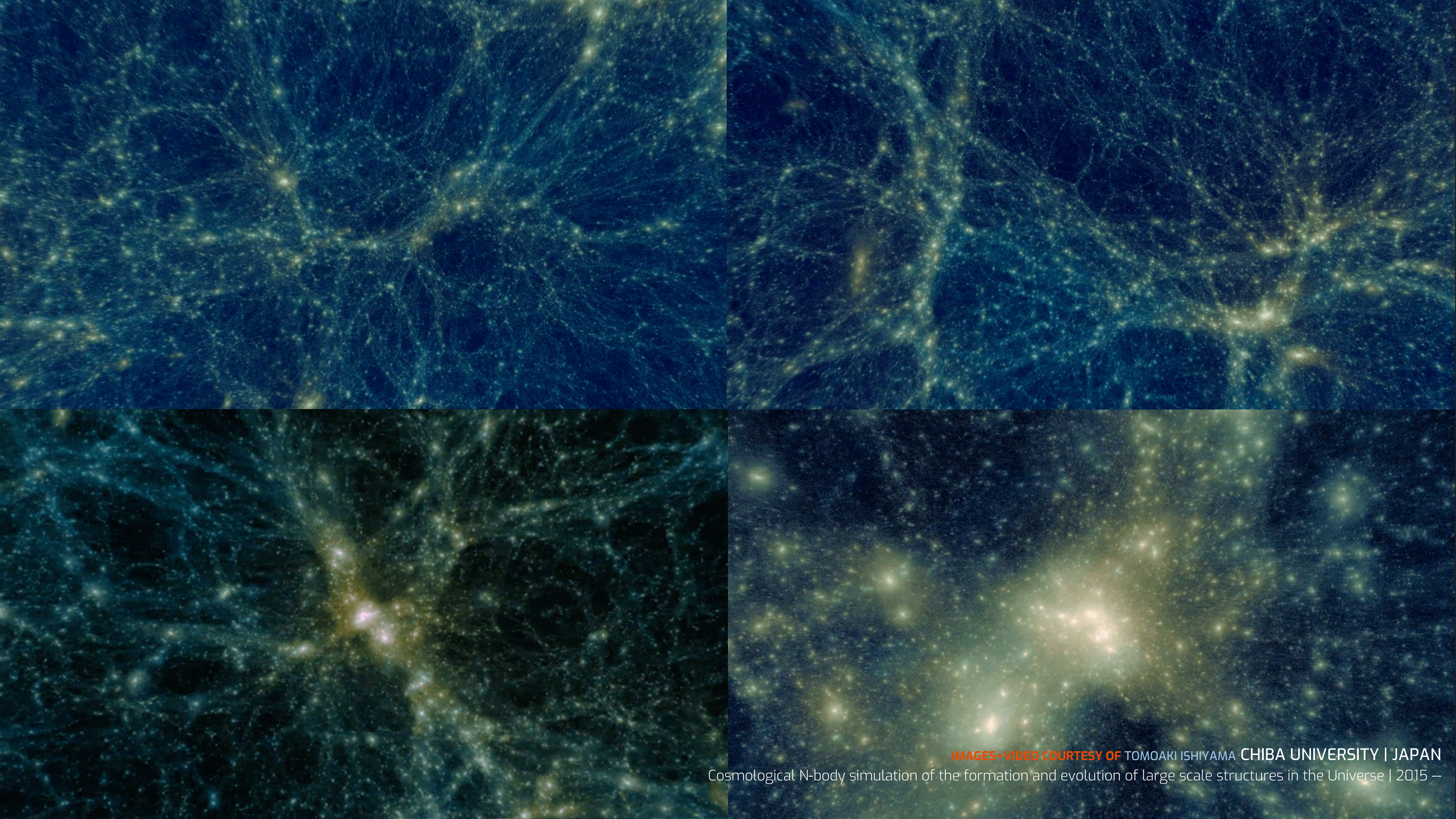
_WHAT IS THE ROLE OF VISUALIZATION



phantom omni







IMAGES+VIDEO COURTESY OF TOMOAKI ISHIYAMA CHIBA UNIVERSITY | JAPAN

Cosmological N-body simulation of the formation and evolution of large scale structures in the Universe | 2015 --

DATA2DISCOVERY

SCOTT DAVIDOFF JPL

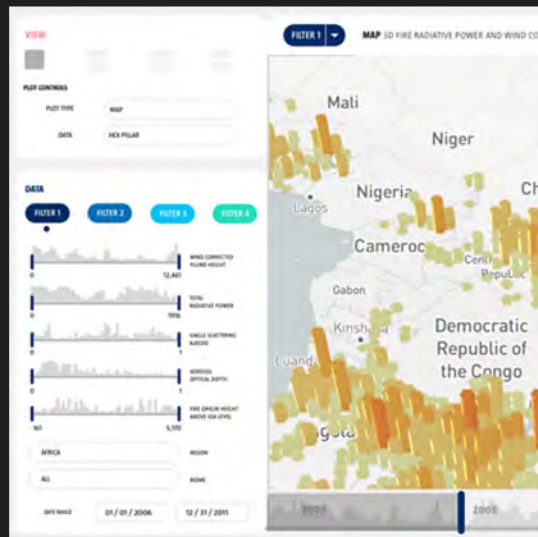
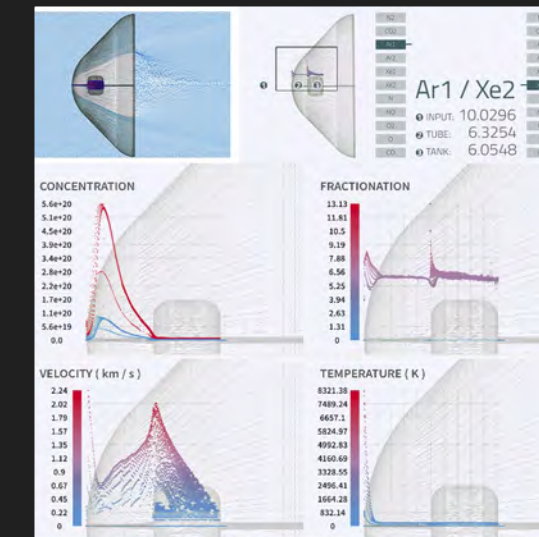
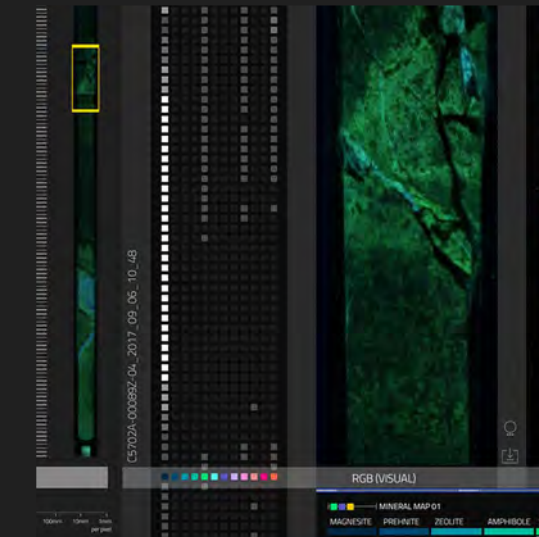
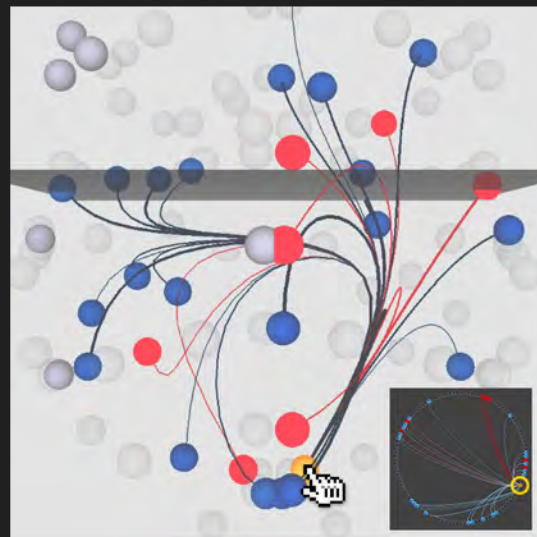
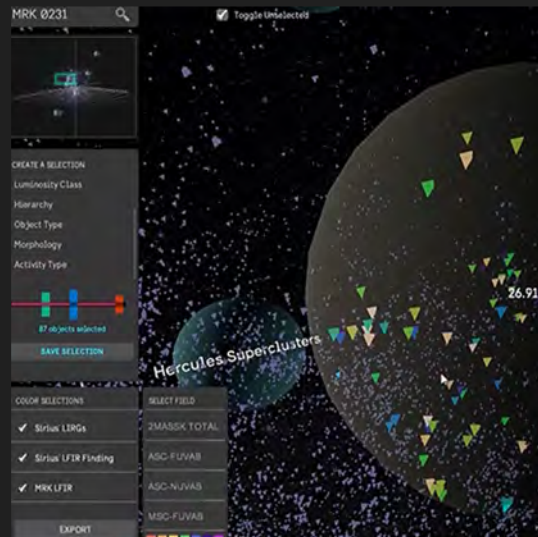
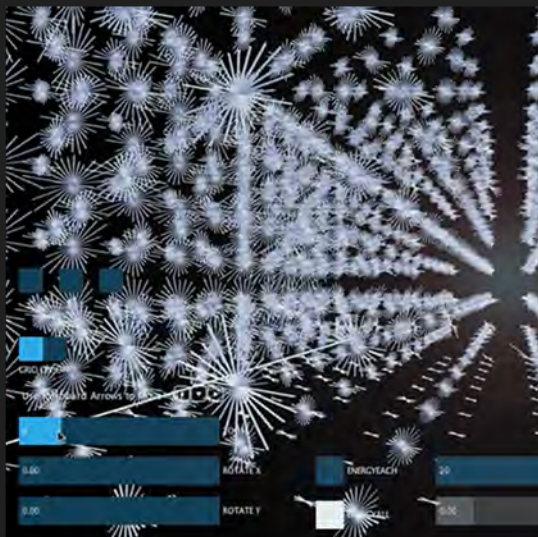
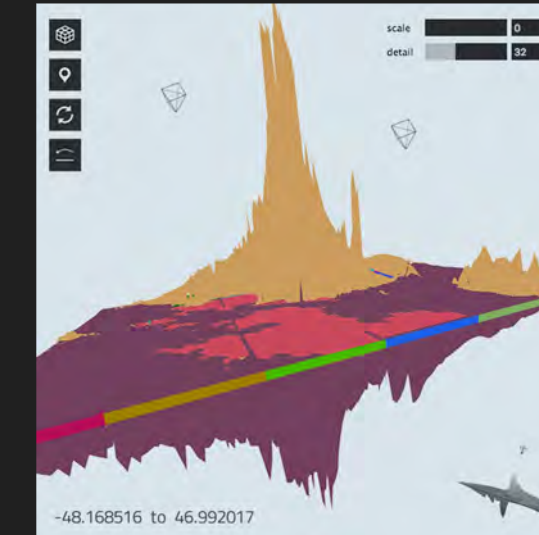
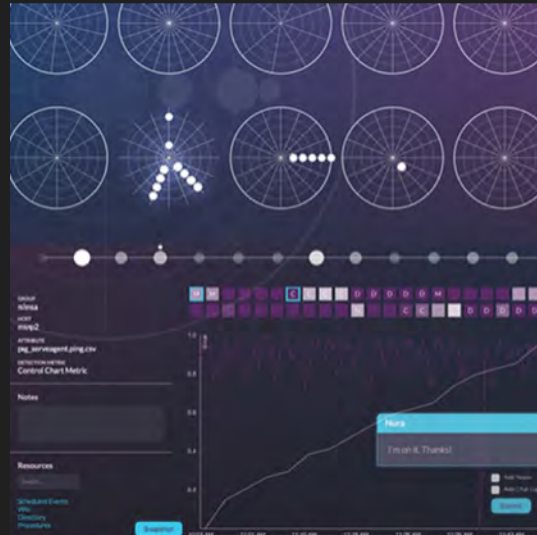
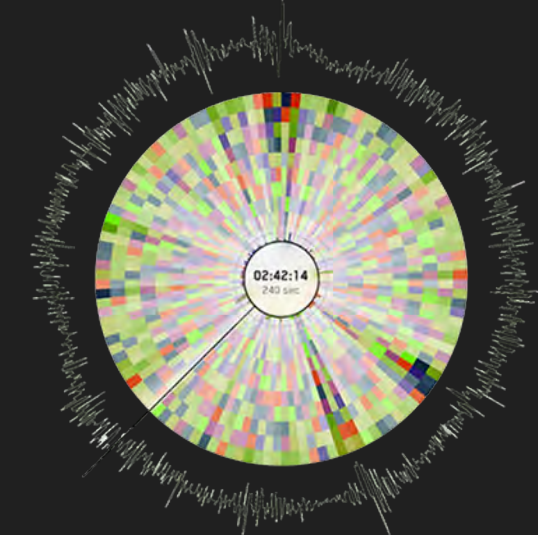
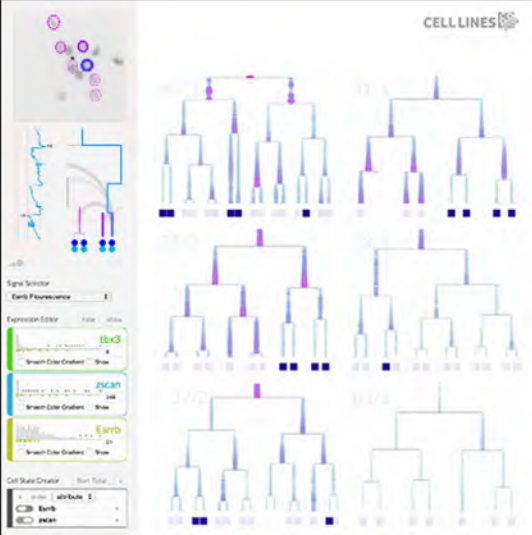
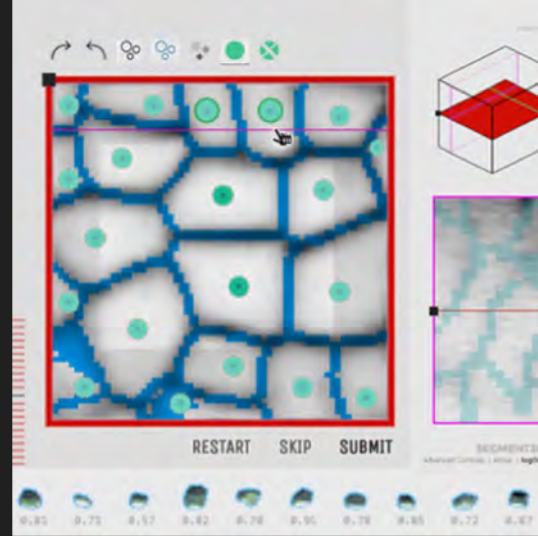
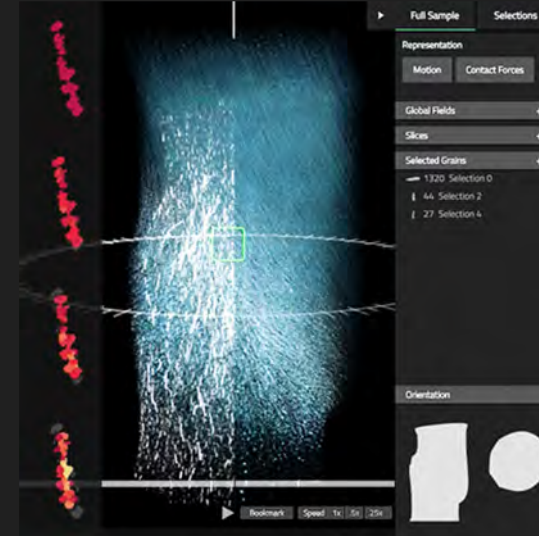
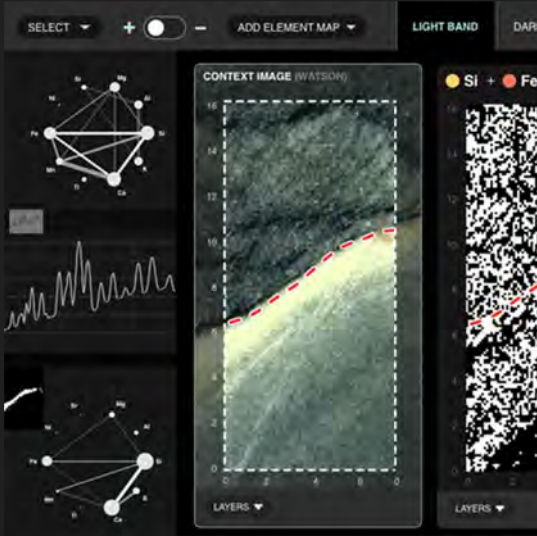
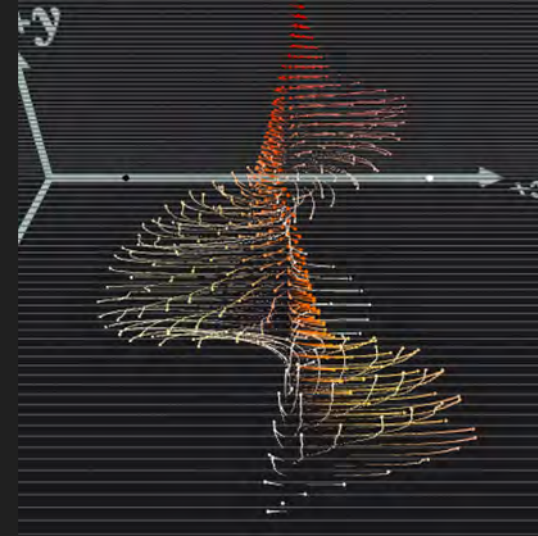
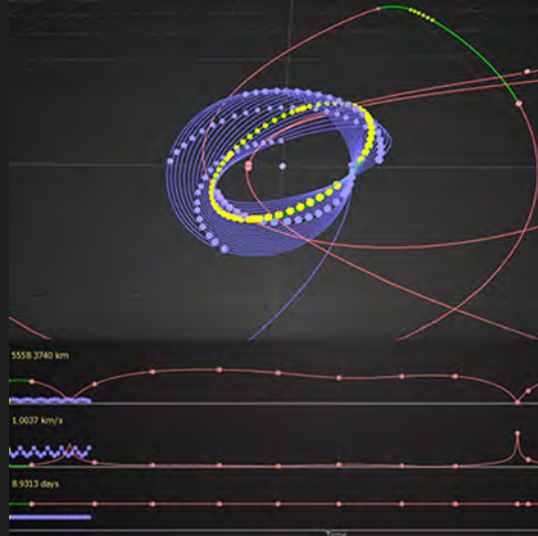
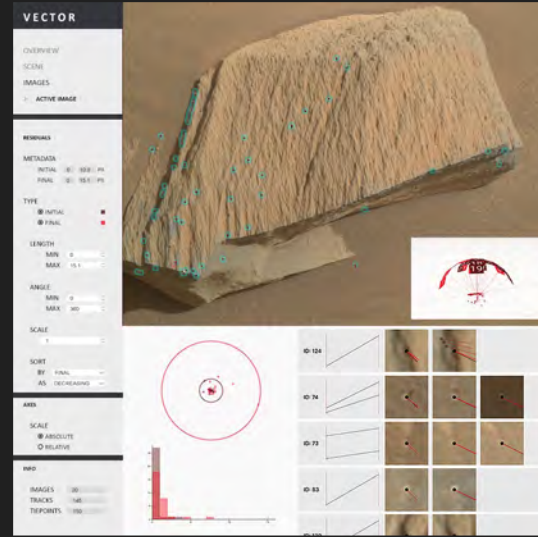
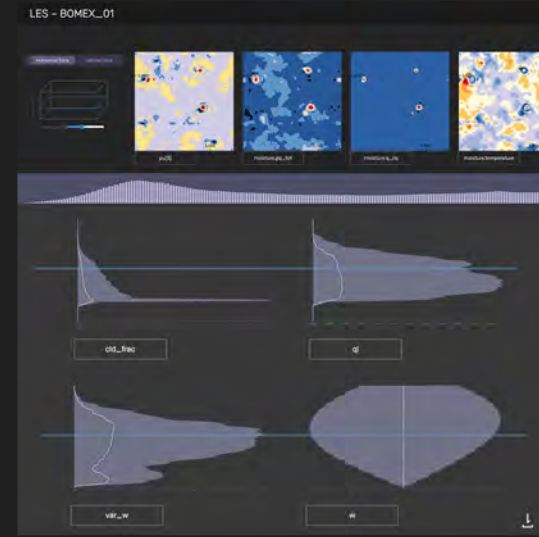
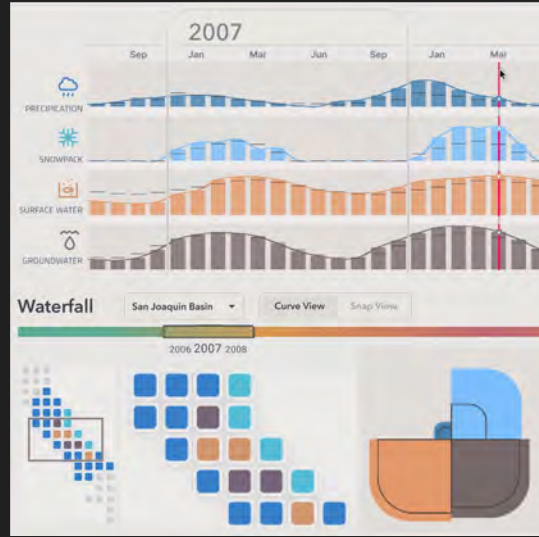
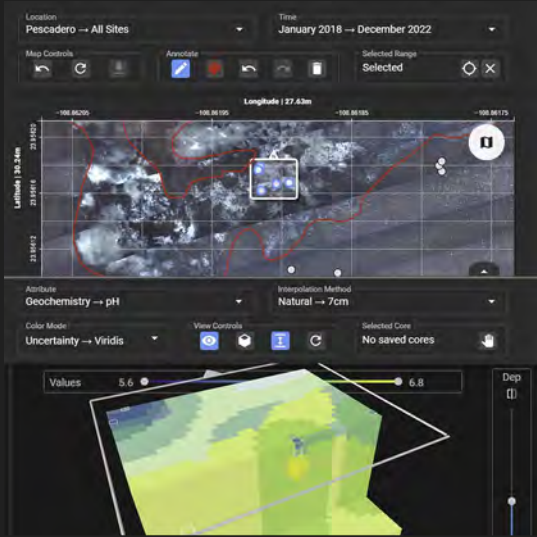
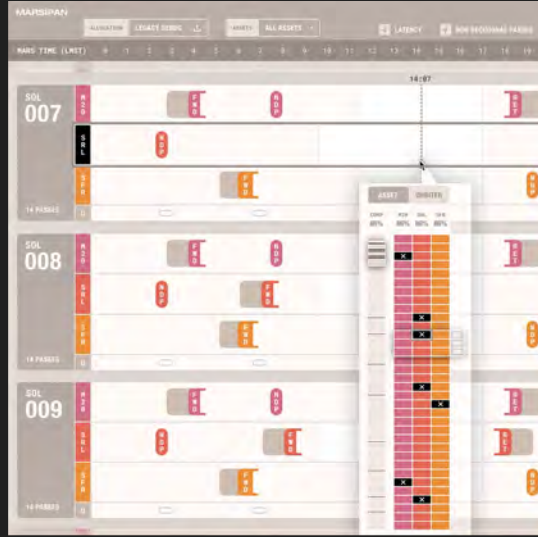
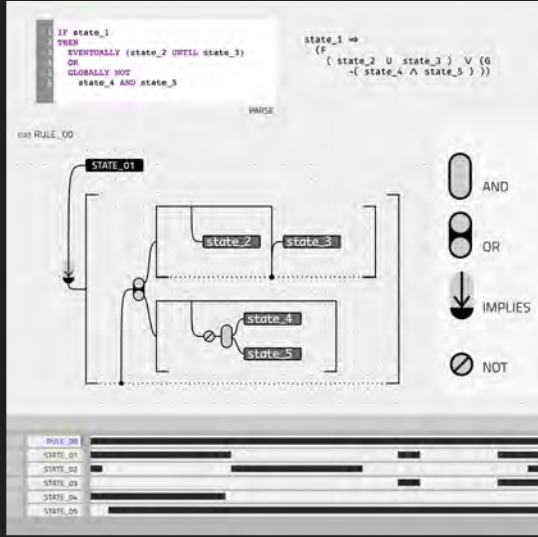
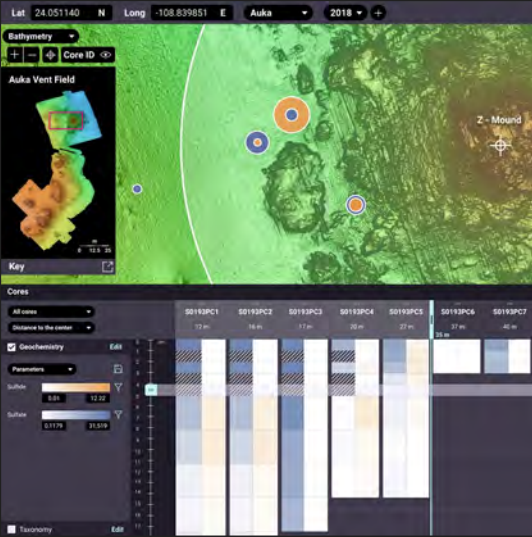
KRYS BLACKWOOD JPL

MAGGIE HENDRIE ART CENTER

HILLARY MUSHKIN CALTECH

SANTIAGO LOMBAYDA CALTECH+ARTCENTER





DATA2DISCOVERY|LIGO



WILLIAM LINDMEIER, STEPHEN BADER, & LUNA LIE [in collaboration with RANA ADHIKARI] **LIGO INTERFEROMETER WATCH**
Interface to visualize and analyzed hundred of data channels from LIGO Interferometer | DATA2DISCOVERY 2014 --

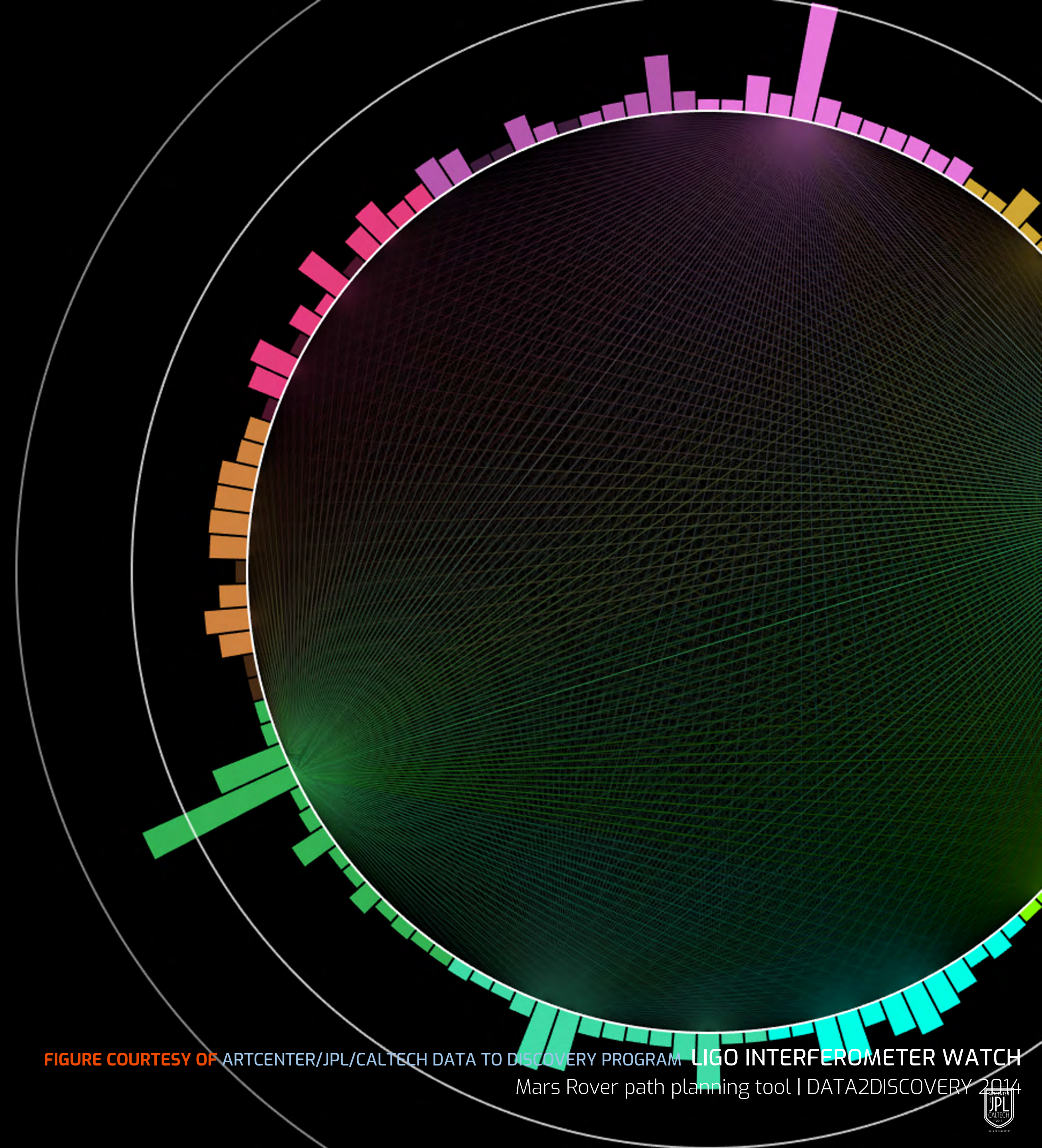
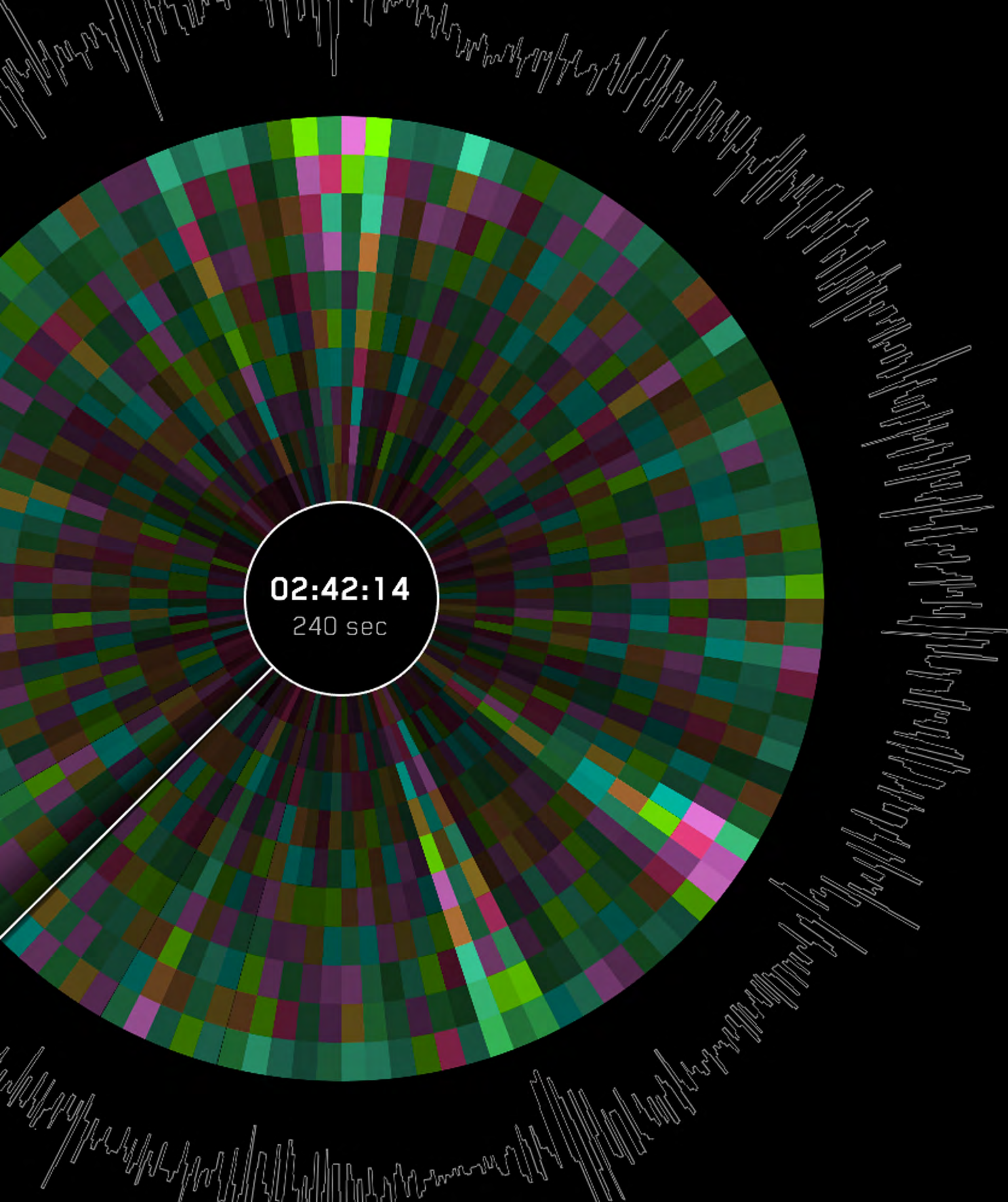
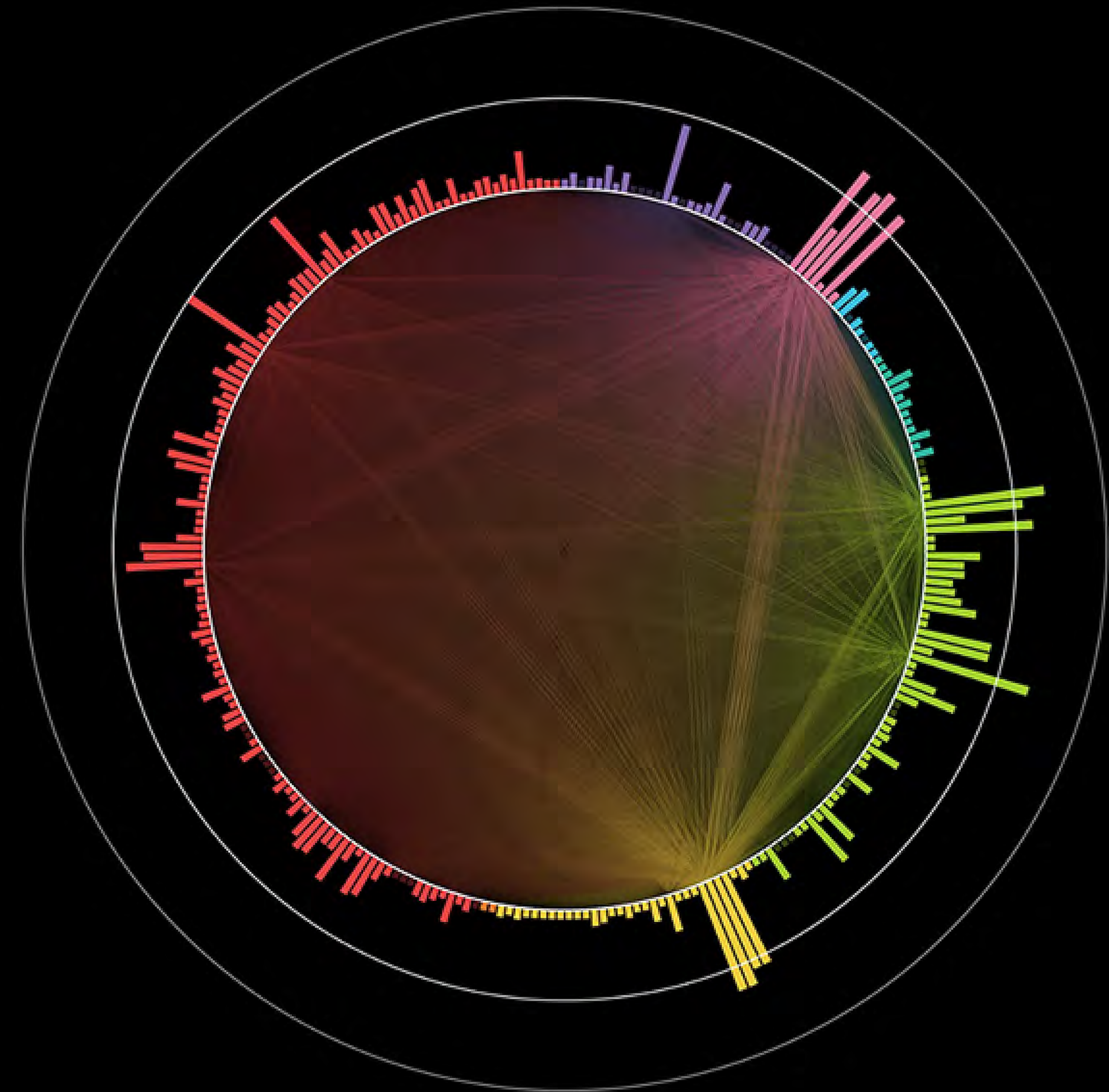
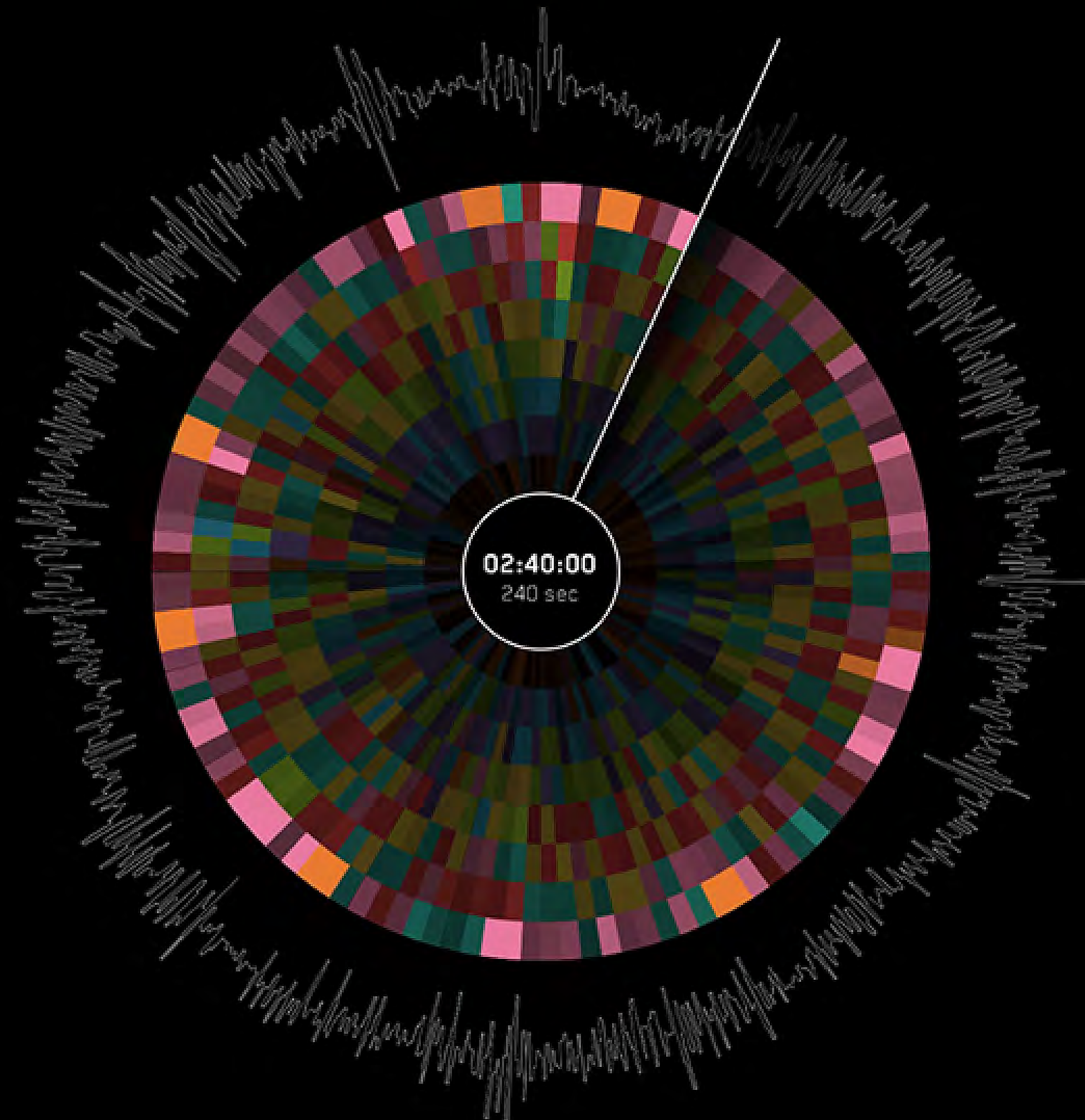


FIGURE COURTESY OF ARTCENTER/JPL/CALTECH DATA TO DISCOVERY PROGRAM LIGO INTERFEROMETER WATCH
Mars Rover path planning tool | DATA2DISCOVERY 2014

All Channels → Subsystem → Select a Category:

- Aux Length Stabilization
- Angular Sensing + Control
- Calculated Values
- Input Optics
- Length Sensing + Control
- Physical Environmental Monitors
- Pre-Stabilized Laser
- Mirror Suspension



Plugin: **Signal Change**

Sort: **Bundle**

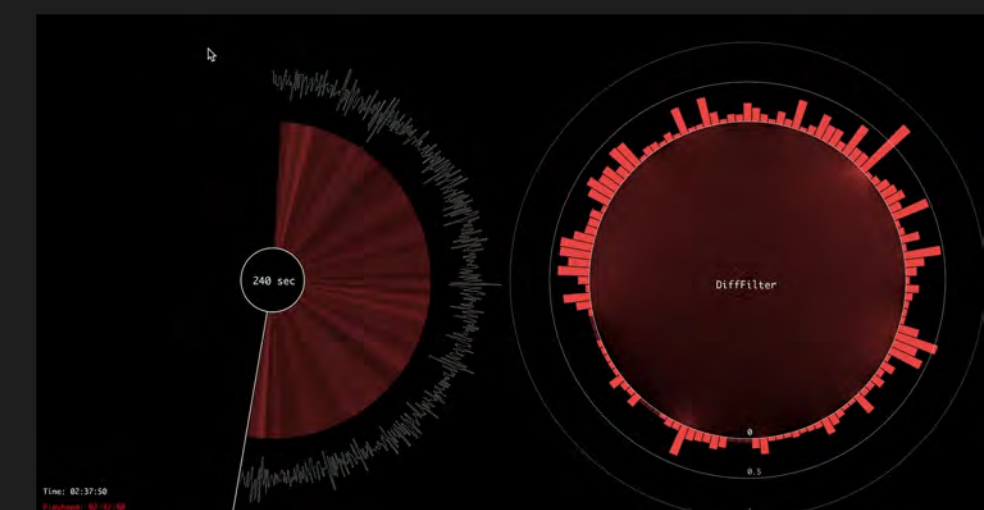
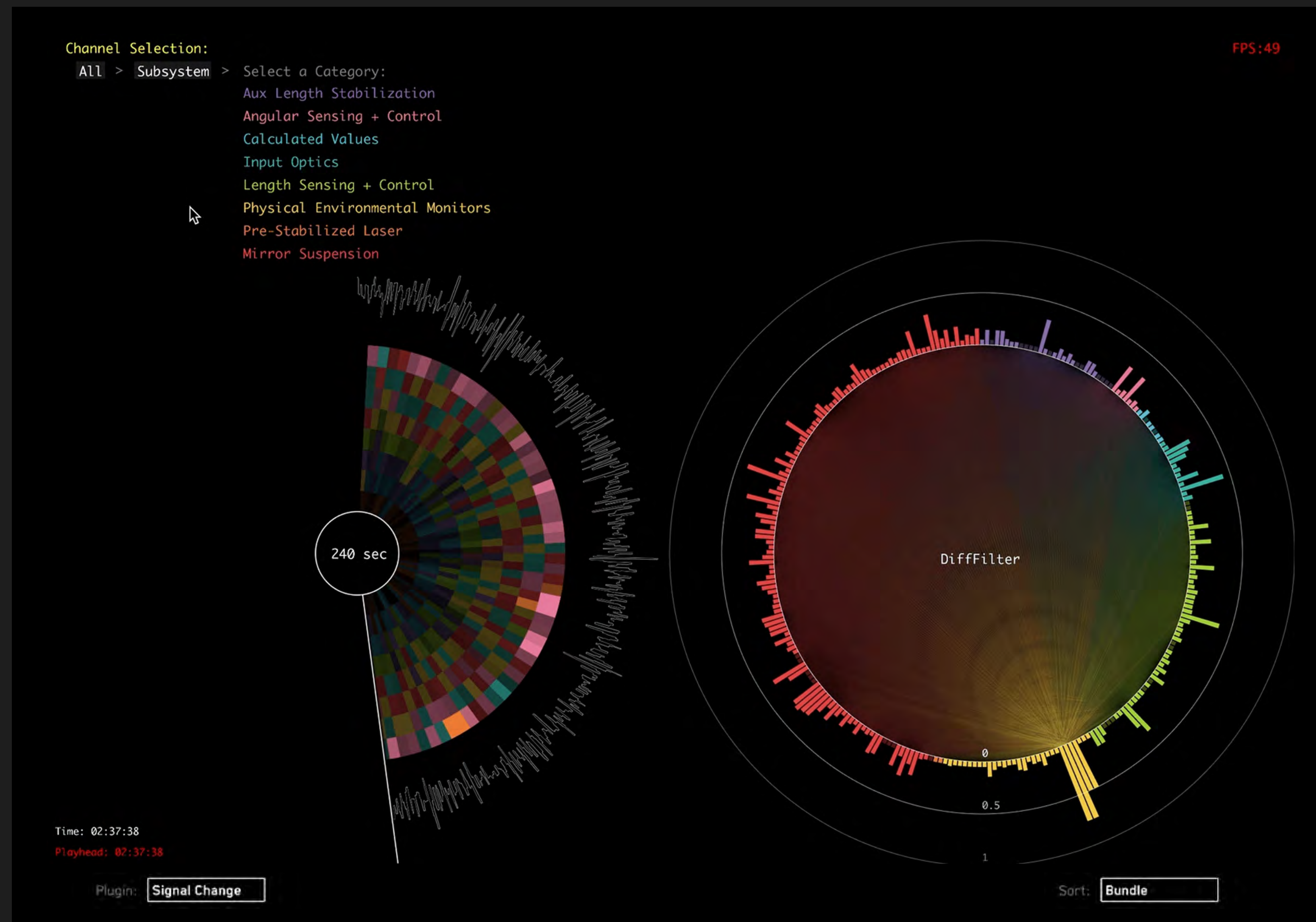
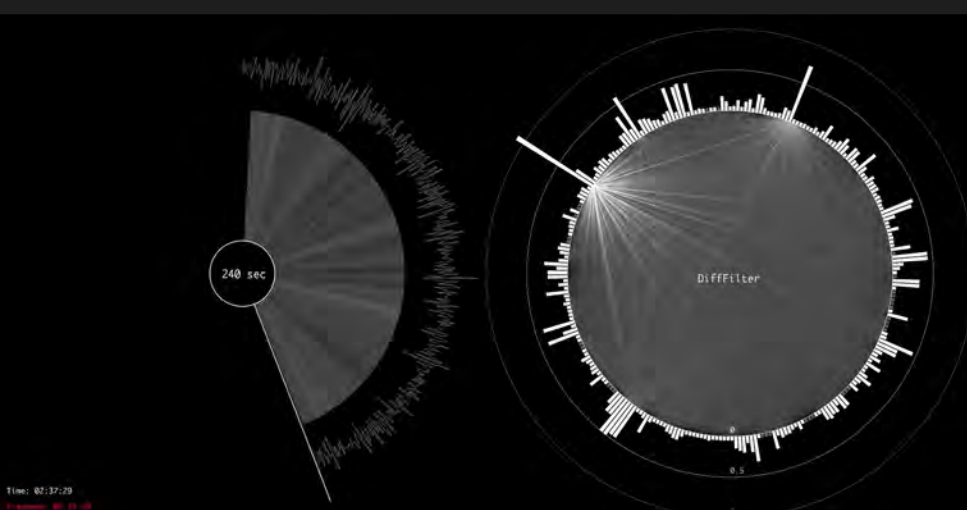


FIGURE COURTESY OF ARTCENTER/JPL/CALTECH DATA TO DISCOVERY PROGRAM **LIGO INTERFEROMETER WATCH**

Mars Rover path planning tool | DATA2DISCOVERY 2014



DATA2DISCOVERY|RSKETCH



FIGURE COURTESY OF ARTCENTER/JPL/CALTECH DATA TO DISCOVERY PROGRAM **RSKETCH**
Mars Rover path planning tool | DATA2DISCOVERY 2015

TERRAIN OVERLAYS

☒ Hazards

☒ Elevation

☒ Slope

☐ Terrain Class

50

38

38

92

terrain 1

terrain 2

terrain 3

terrain 4

terrain 5

PATH OVERLAYS

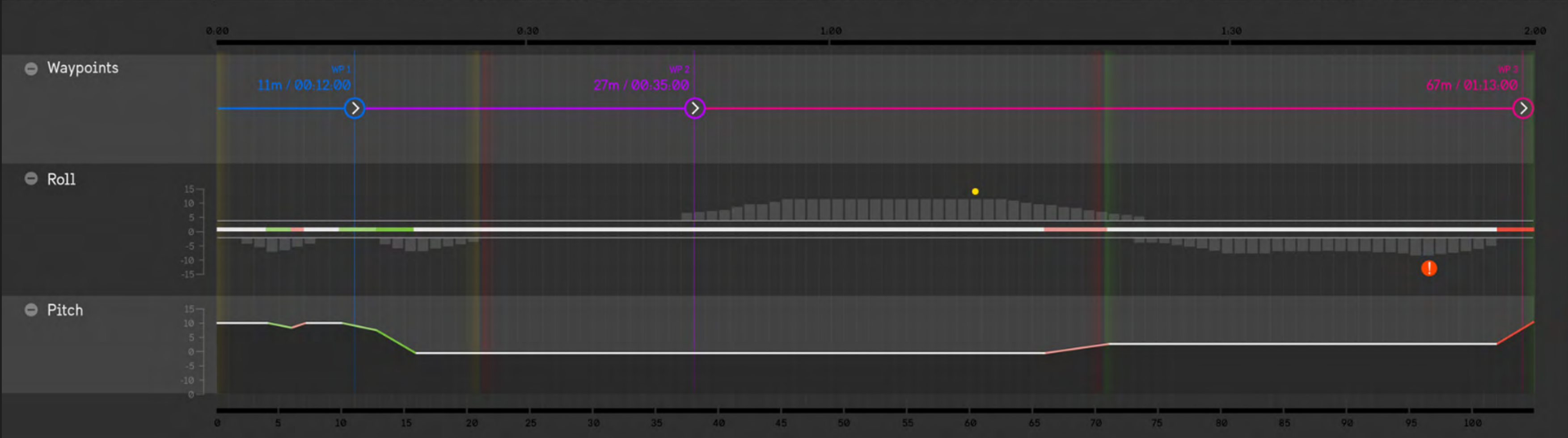
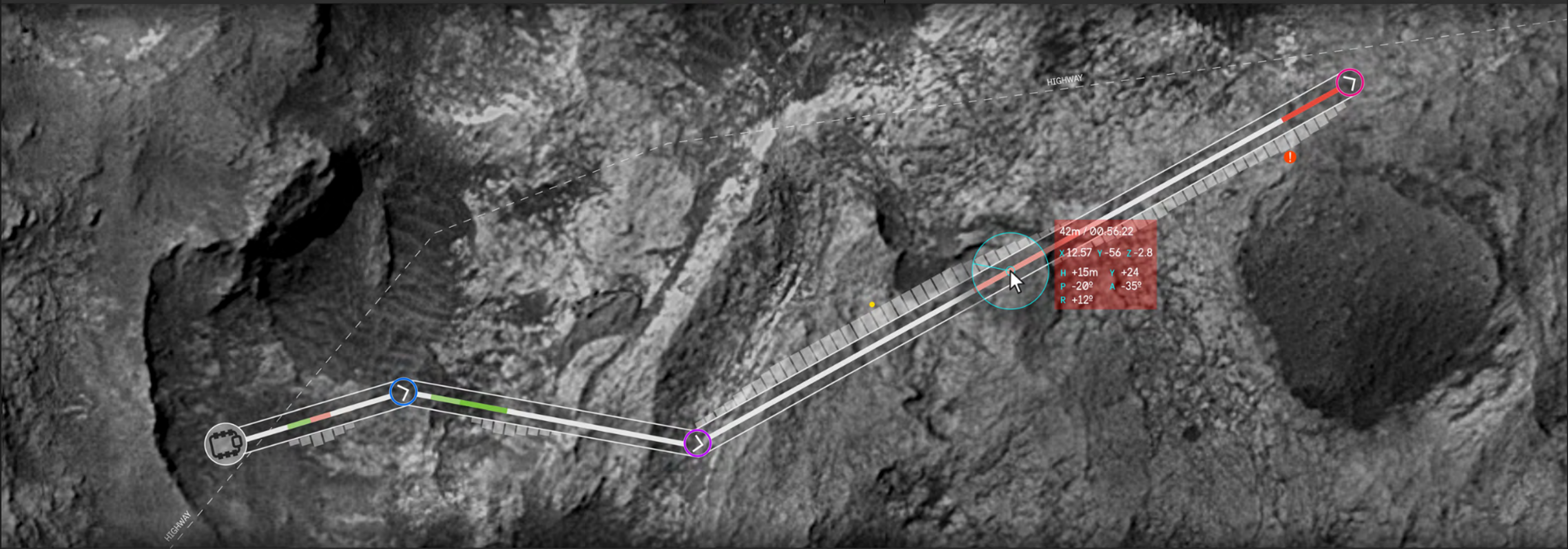
☒ Pitch

☒ Roll

☐ Relative Elevation

☐ Error

☒ Drive Mode



Stats

distance duration

110 km 3 waypoints

! max Roll

97 km terrain type 5

12° R

! max Pitch

13 km terrain type 4

18°

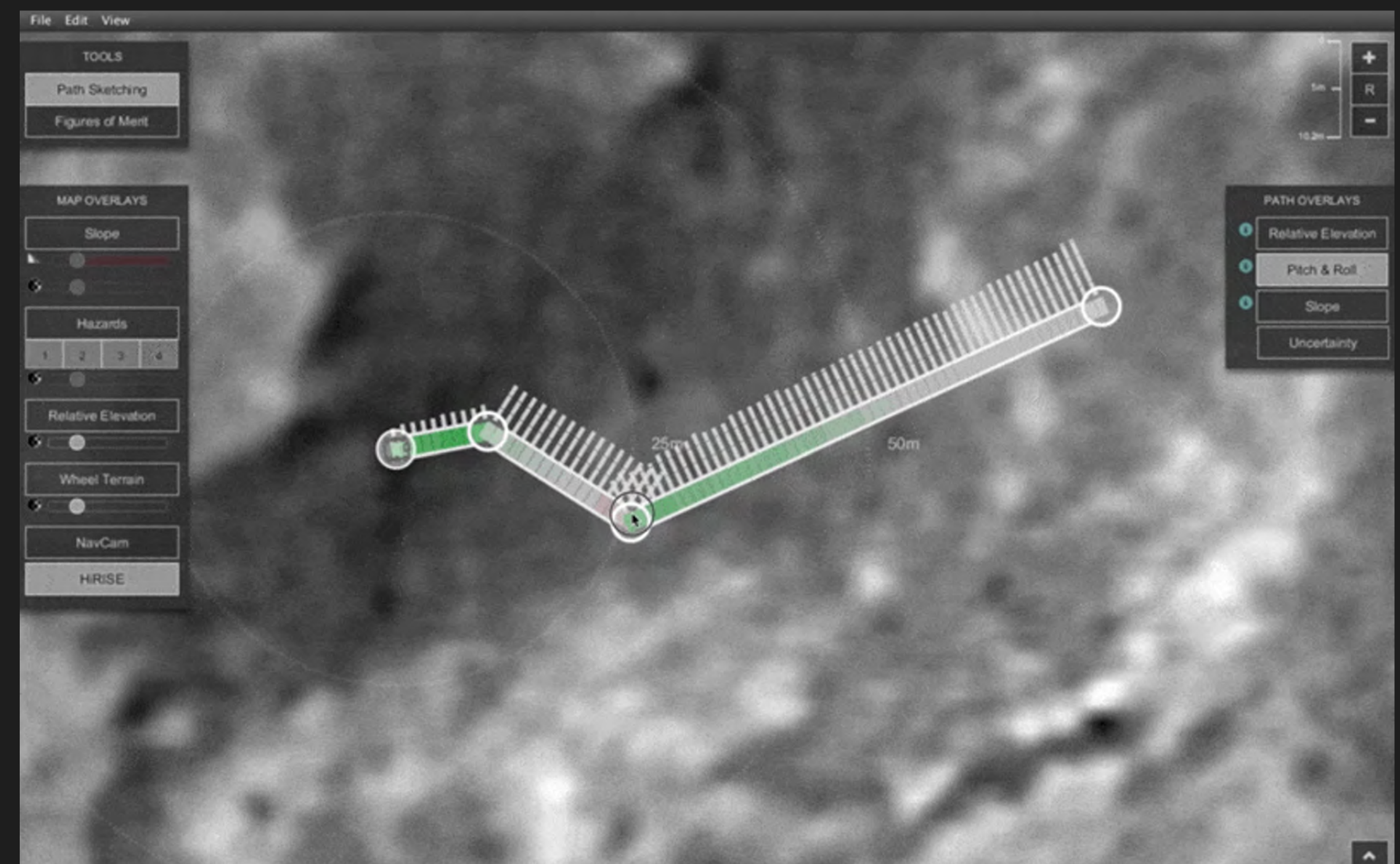
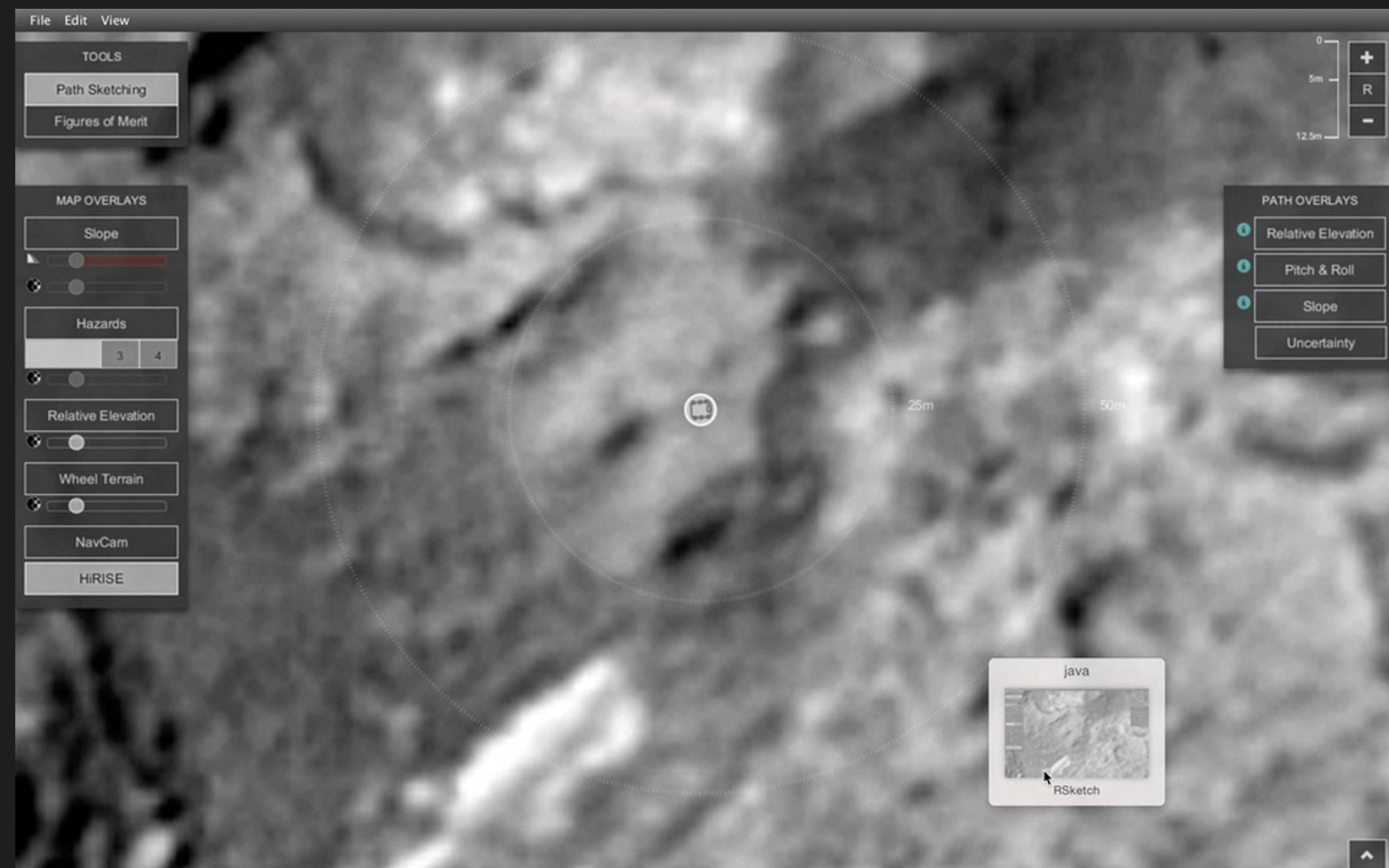


FIGURE COURTESY OF ARTCENTER/JPL/CALTECH DATA TO DISCOVERY PROGRAM **RSKETCH**
Mars Rover path planning tool | DATA2DISCOVERY 2015

EHLMANNLAB|COREINSPECTOR



LAUNCH

ABOUT

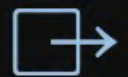
GUIDE

DOWNLOAD

SCIENCE

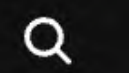
 BUGS

OMAN CORE CORE INSPECTOR ^{BETA}

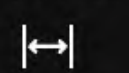
LAUNCH VIEWER 



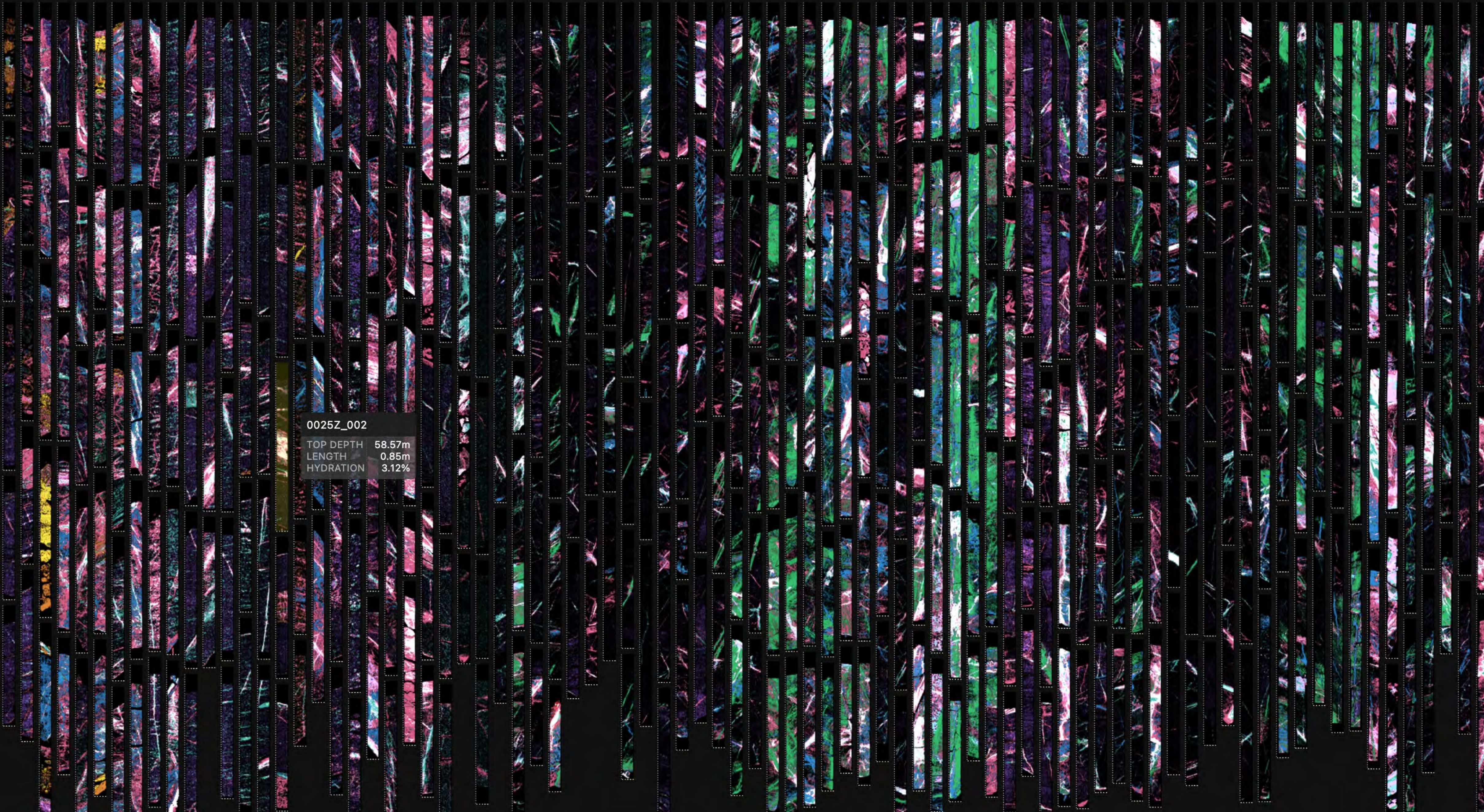
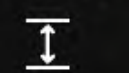
ZOOM



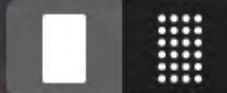
HORIZONTAL
DISTANCE



VERTICAL
DISTANCE



0025Z_002
TOP DEPTH 58.57m
LENGTH 0.85m
HYDRATION 3.12%



ZOOM

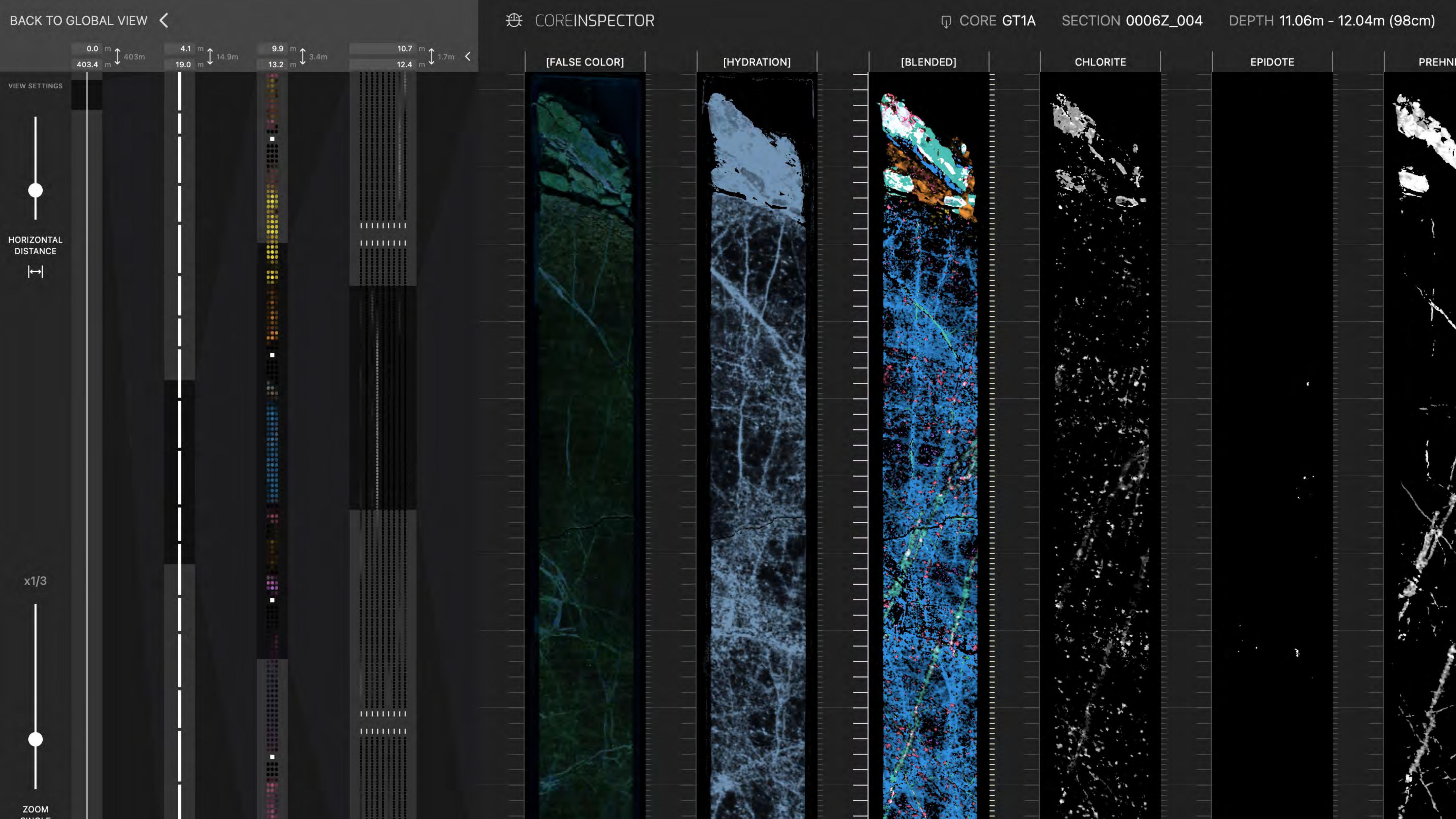


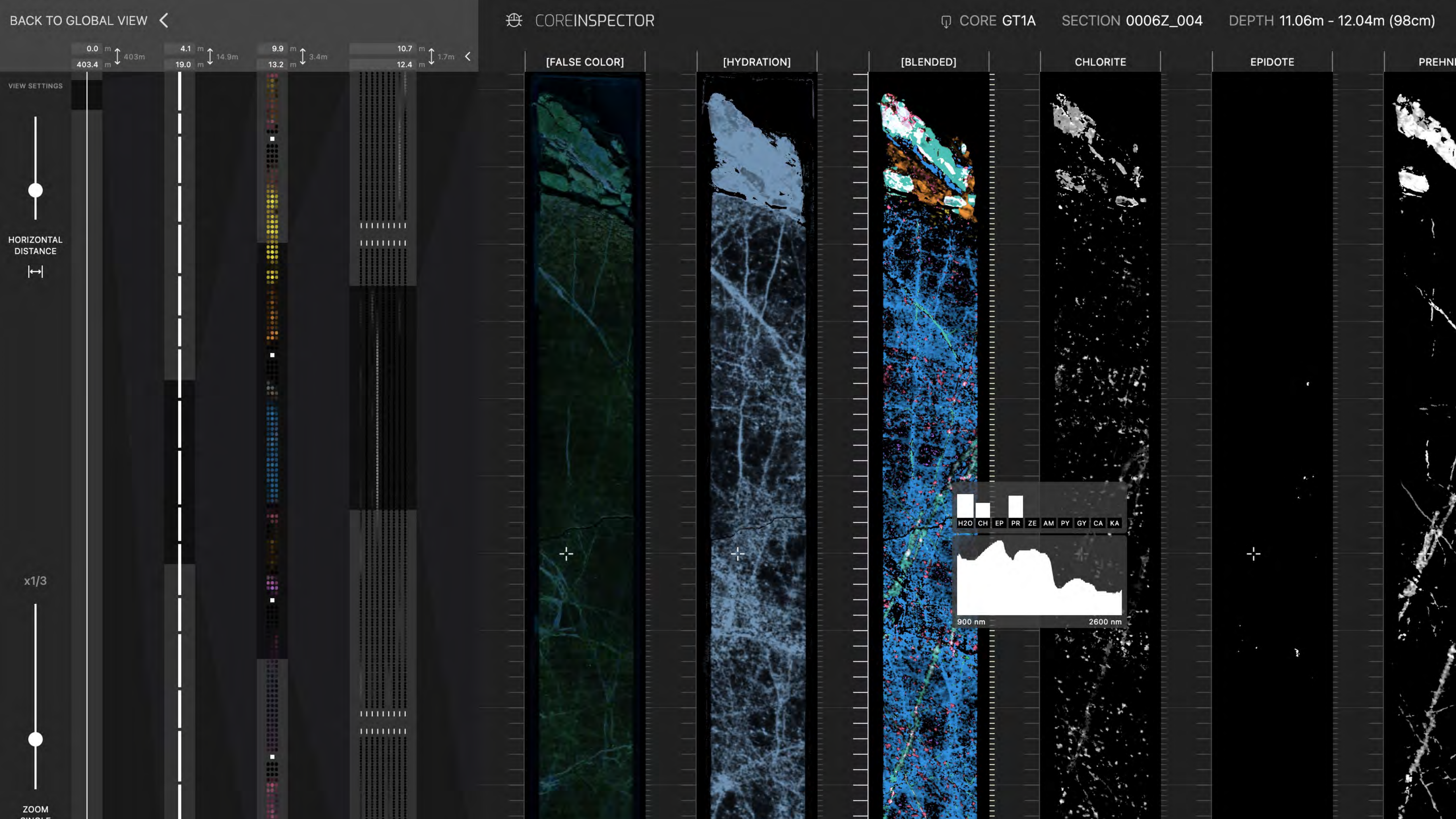
HORIZONTAL
DISTANCE



VERTICAL
DISTANCE

0006Z_003
TOP DEPTH 10.20m
LENGTH 0.86m
HYDRATION 12.19%





0.0 m

403.4 m

403m

4.1 m

19.0 m

14.9m

9.9 m

13.2 m

3.4m

10.7 m

12.4 m

1.7m

VIEW SETTINGS

HORIZONTAL DISTANCE

x1/3

ZOOM

>

[FALSE COLOR]

[HYDRATION]

[BLENDED]

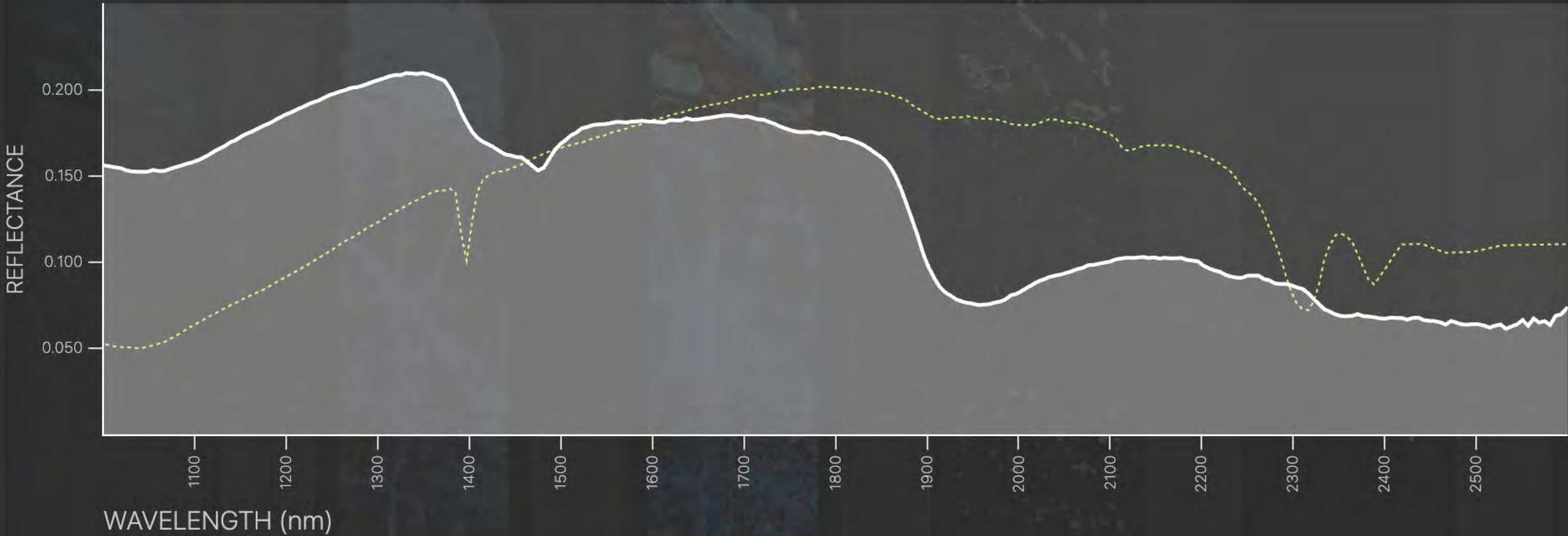
CHLORITE

EPIDOTE

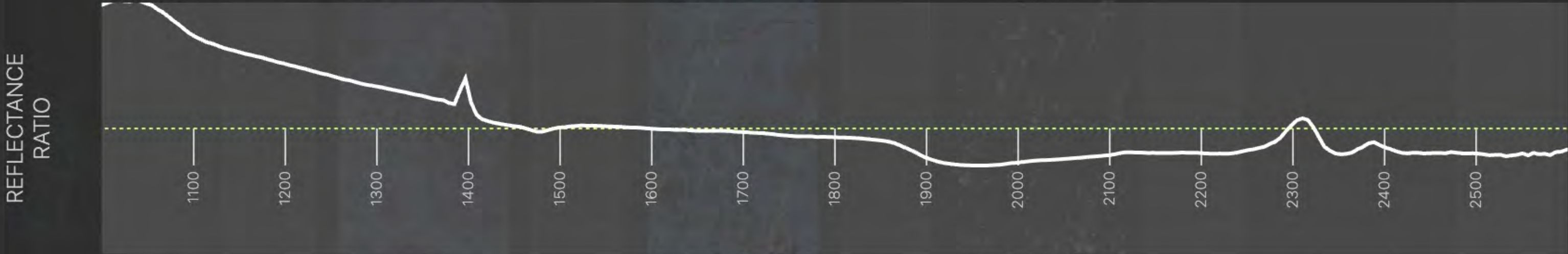
PREHNITE

X 107px Y 1639px

CSV



MINERAL PROFILE ACTINOLITE



[VISUALIZATION PIPELINE]

ACQUIRE

PARSE

FILTER

MINE

REPRESENT

REFINE

INTERACT

WHAT IS DATA VISUALIZATION?

[VISUALIZATION PIPELINE]

OBTAIN THE DATA,
WHETHER FROM A
FILE ON A DISK OR
A SOURCE OVER A
NETWORK.

ACQUIRE

PROVIDE SOME
STRUCTURE FOR
THE DATA'S
MEANING, AND
ORDER IT INTO
CATEGORIES

PARSE

REMOVE ALL BUT
THE DATA OF
INTEREST.

FILTER

APPLY METHODS FROM
STATISTICS OR DATA
MINING AS A WAY TO
DISCERN PATTERNS OR
PLACE DATA IN
MATHEMATICAL
CONTEXT.

MINE

CHOOSE A BASIC
VISUAL MODEL, SUCH
AS A BAR GRAPH,
LIST, OR TREE.

REPRESENT

IMPROVE THE
BASIC
REPRESENTATION
TO MAKE IT
CLEARER AND
MORE VISUALLY
ENGAGING.

REFINE

ADD METHODS FOR
MANIPULATING THE
DATA OR
CONTROLLING WHAT
FEATURES ARE
VISIBLE.

INTERACT

WHAT IS DATA VISUALIZATION?

[VISUALIZATION PIPELINE]

ACQUIRE

PARSE

FILTER

MINE

REPRESENT

REFINE

INTERACT

WHAT IS DATA VISUALIZATION?

[VISUALIZATION PIPELINE]



WHAT IS DATA VISUALIZATION?

[VISUALIZATION PIPELINE]



WHAT IS DATA VISUALIZATION?

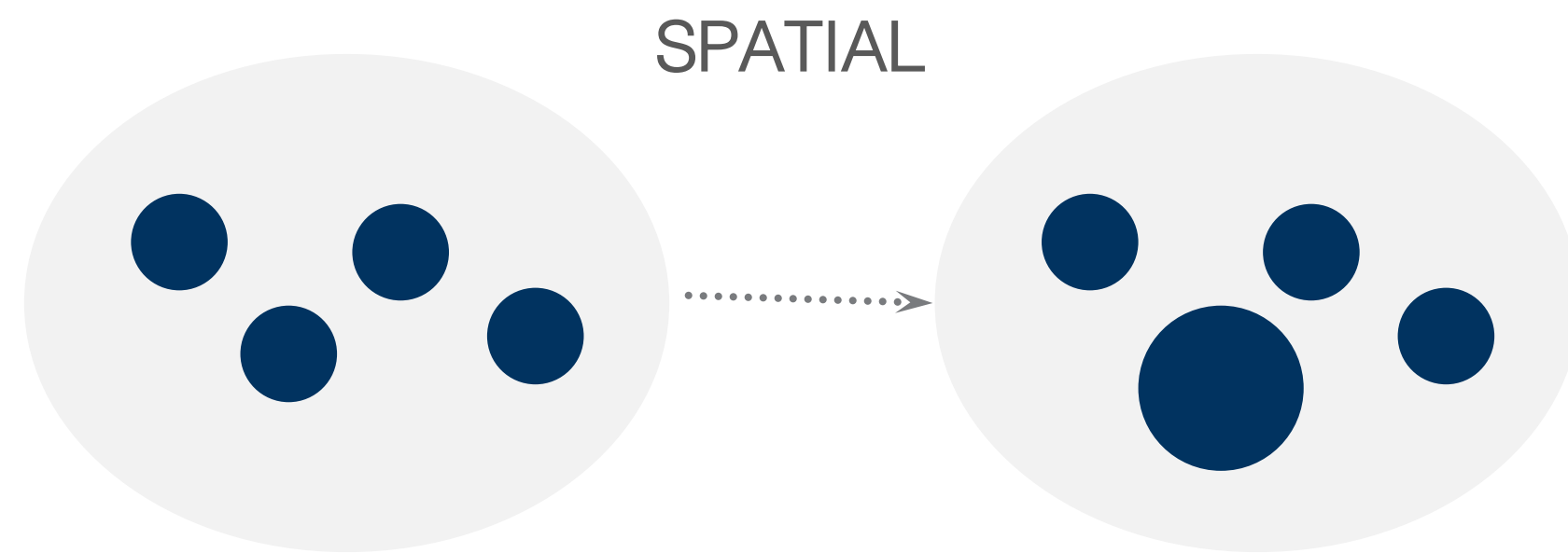
[VISUALIZATION PIPELINE]



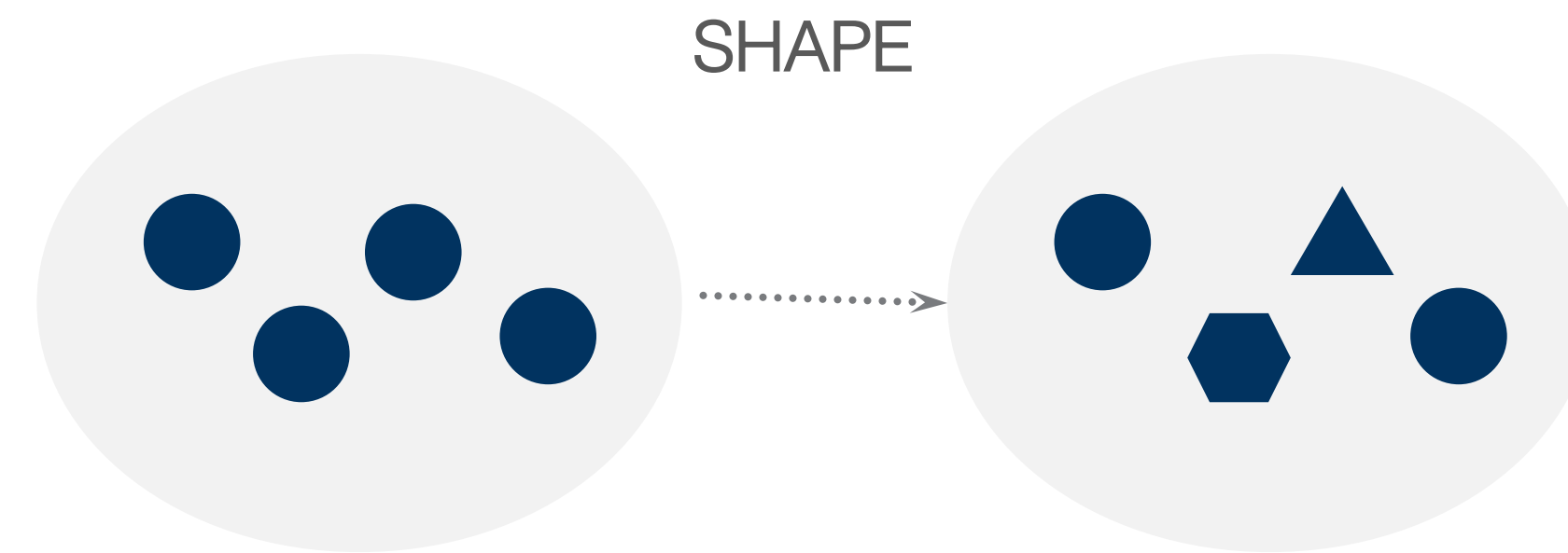
WHAT IS DATA VISUALIZATION?

HOW DO WE REPRESENT DATA?

BASIC DATA ENCODING

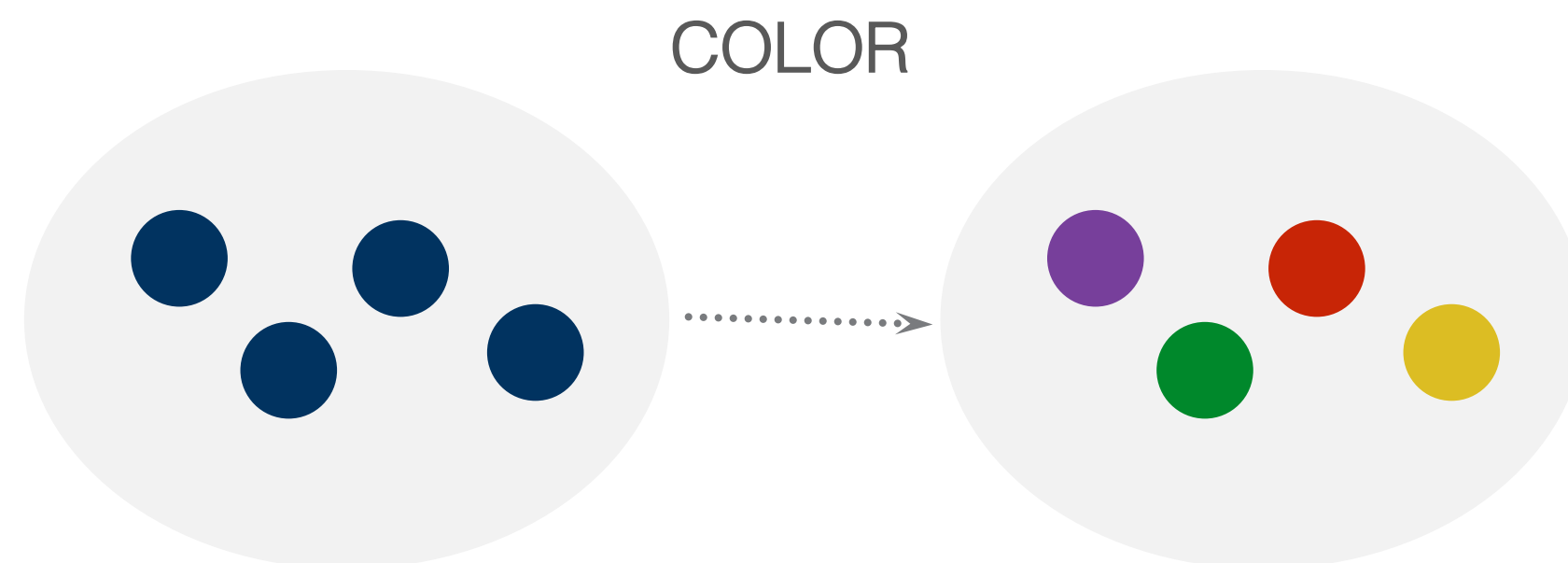


position | scale | orientation

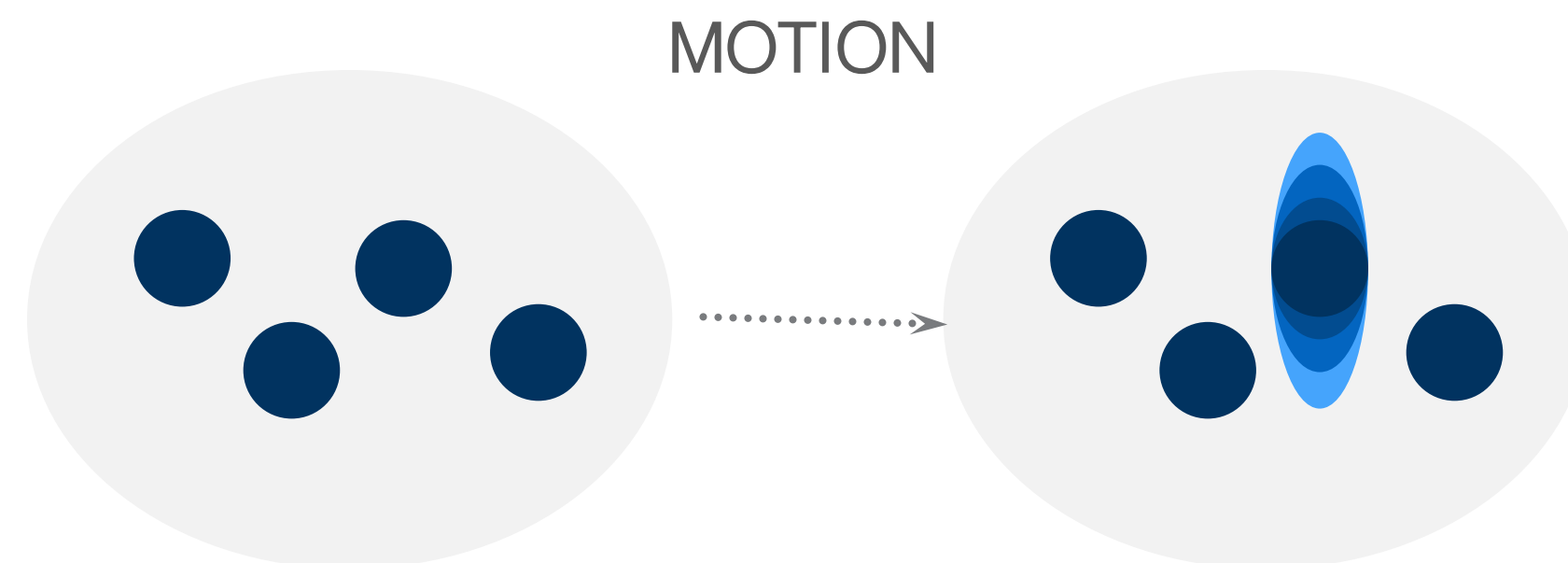


distinctive glyphs | bumps | points | whiskers

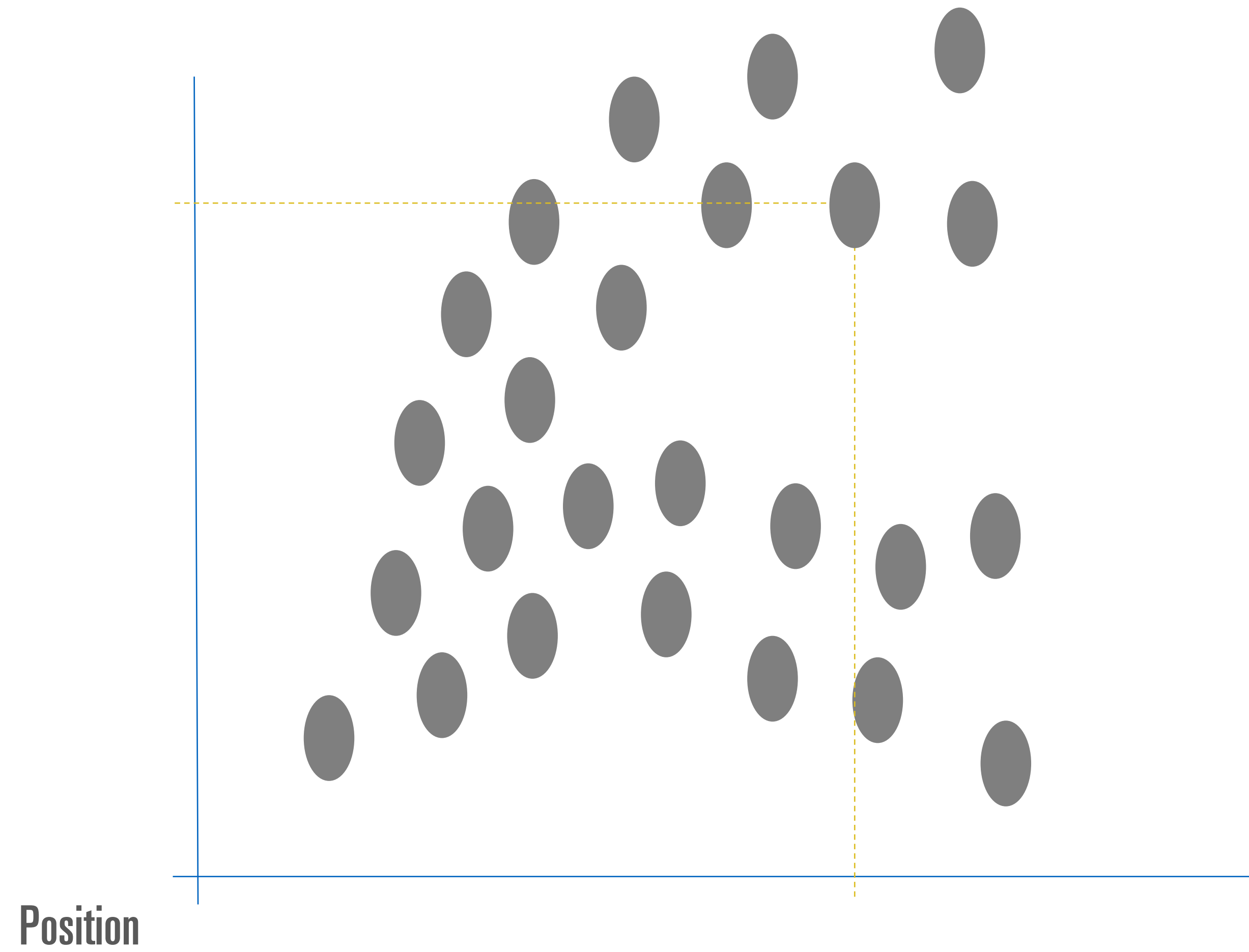
BASIC DATA ENCODING

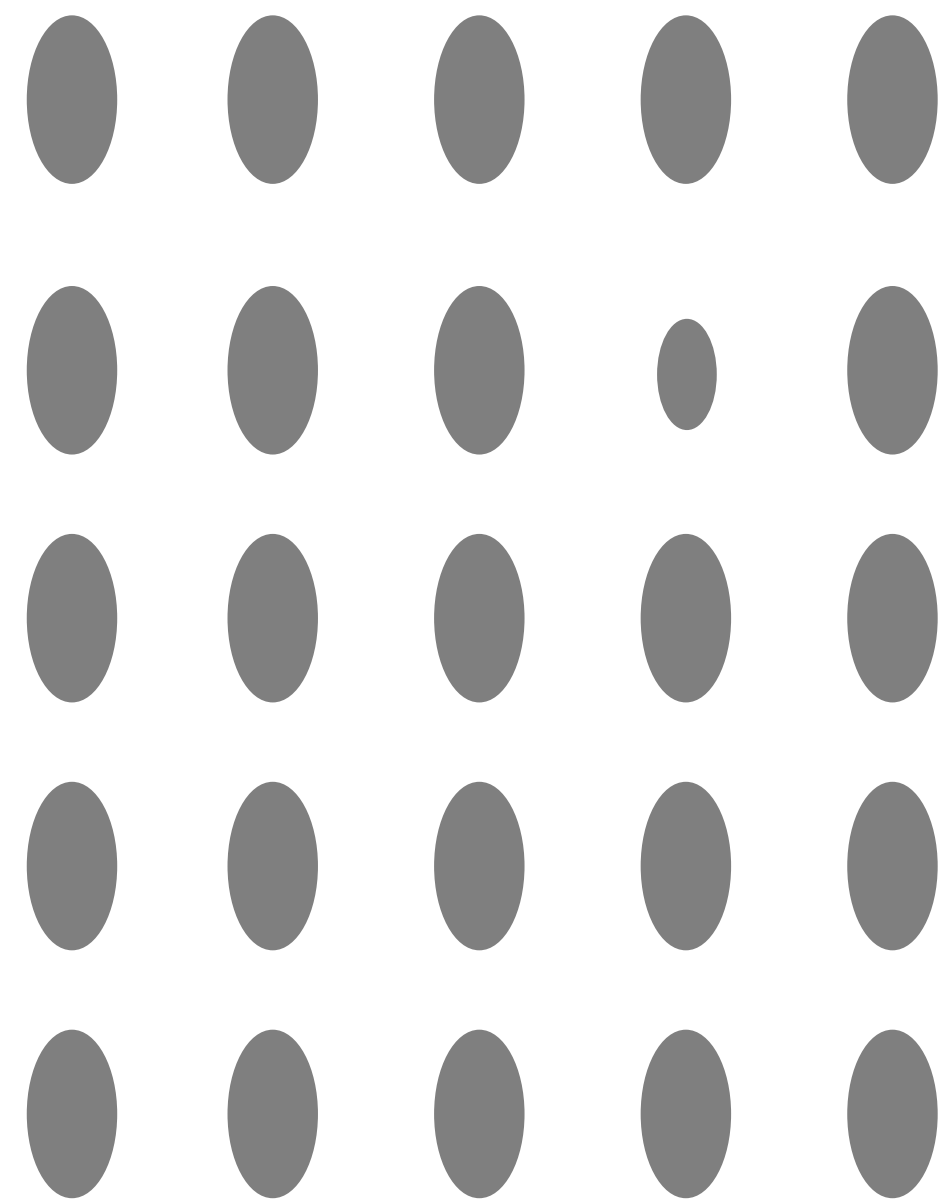


luminosity | hue | saturation | texture

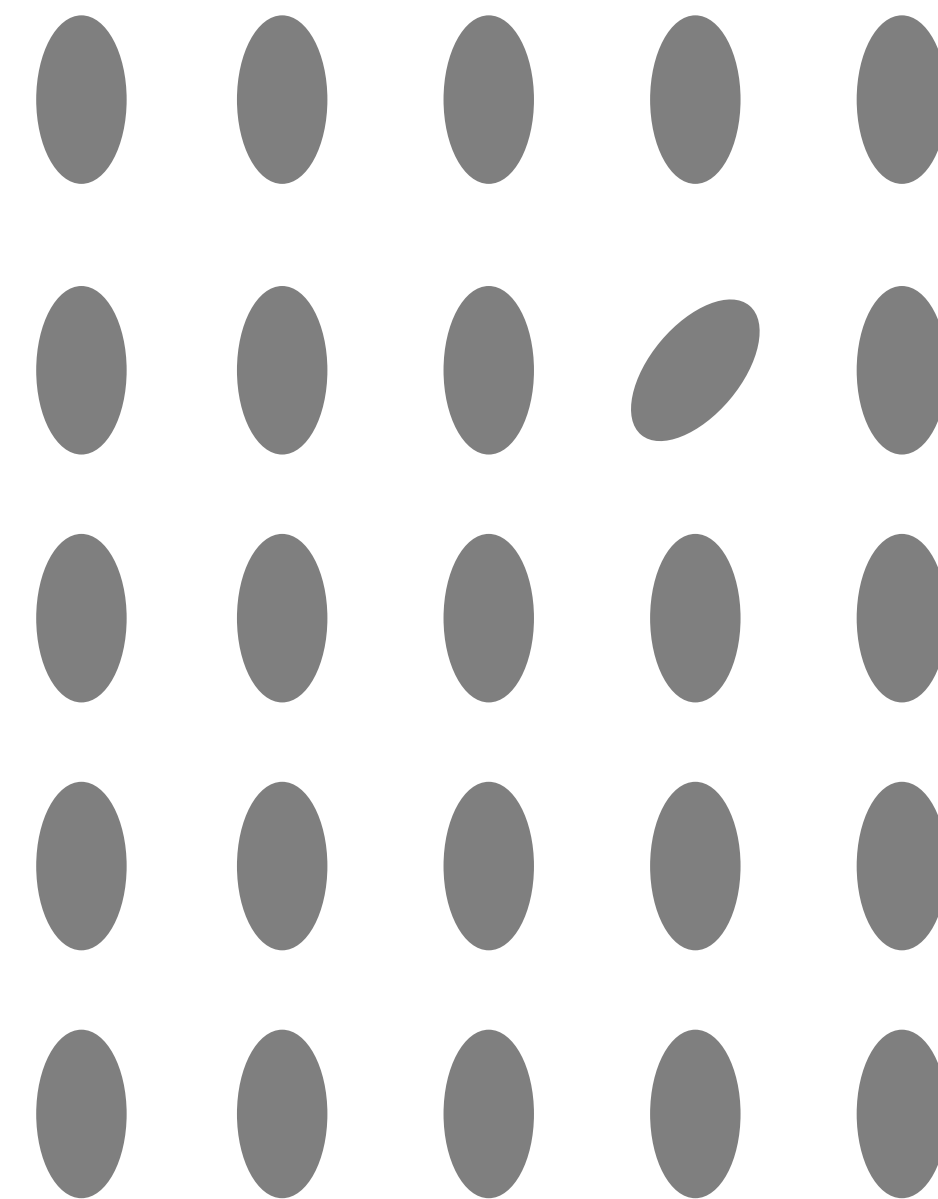


vibration | rotation | deformation

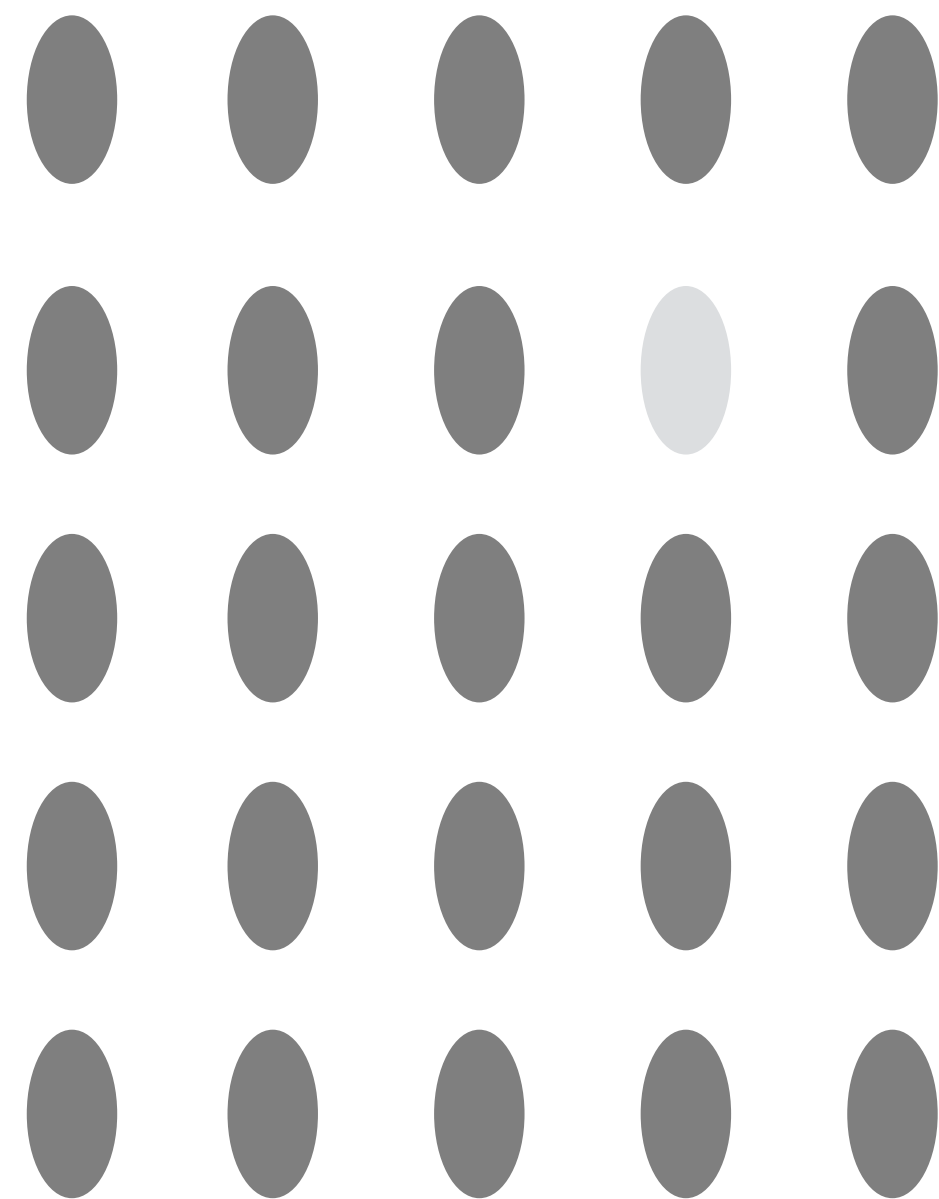




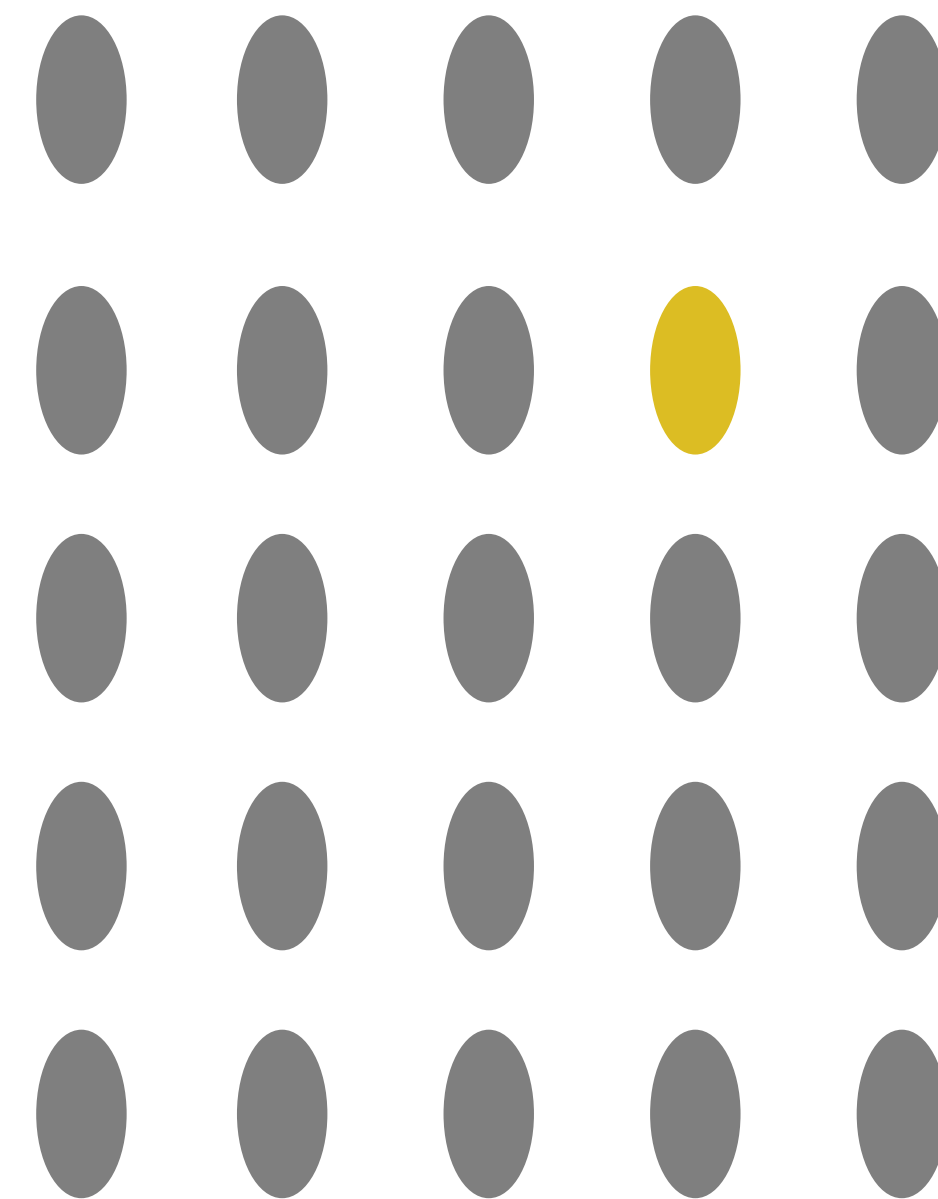
Scale



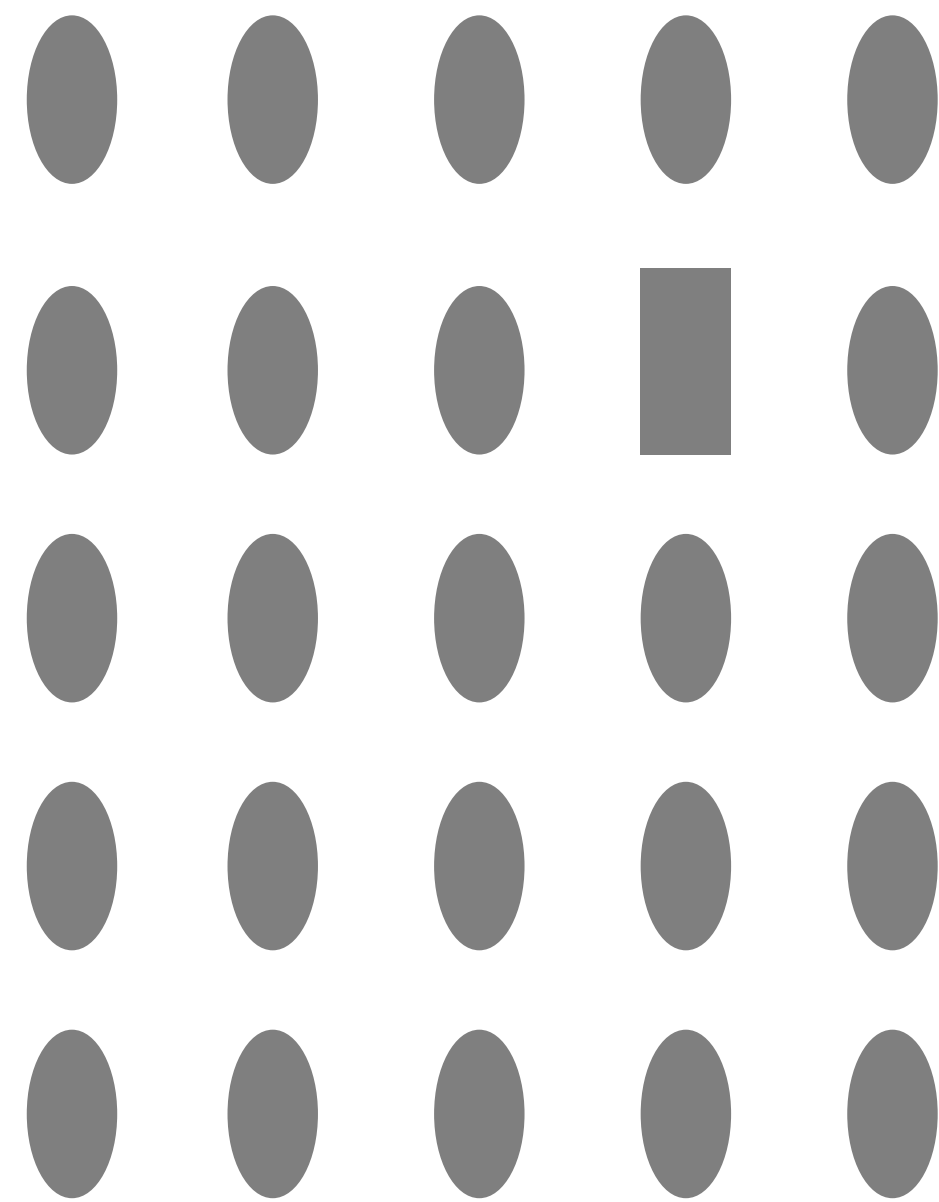
Orientation



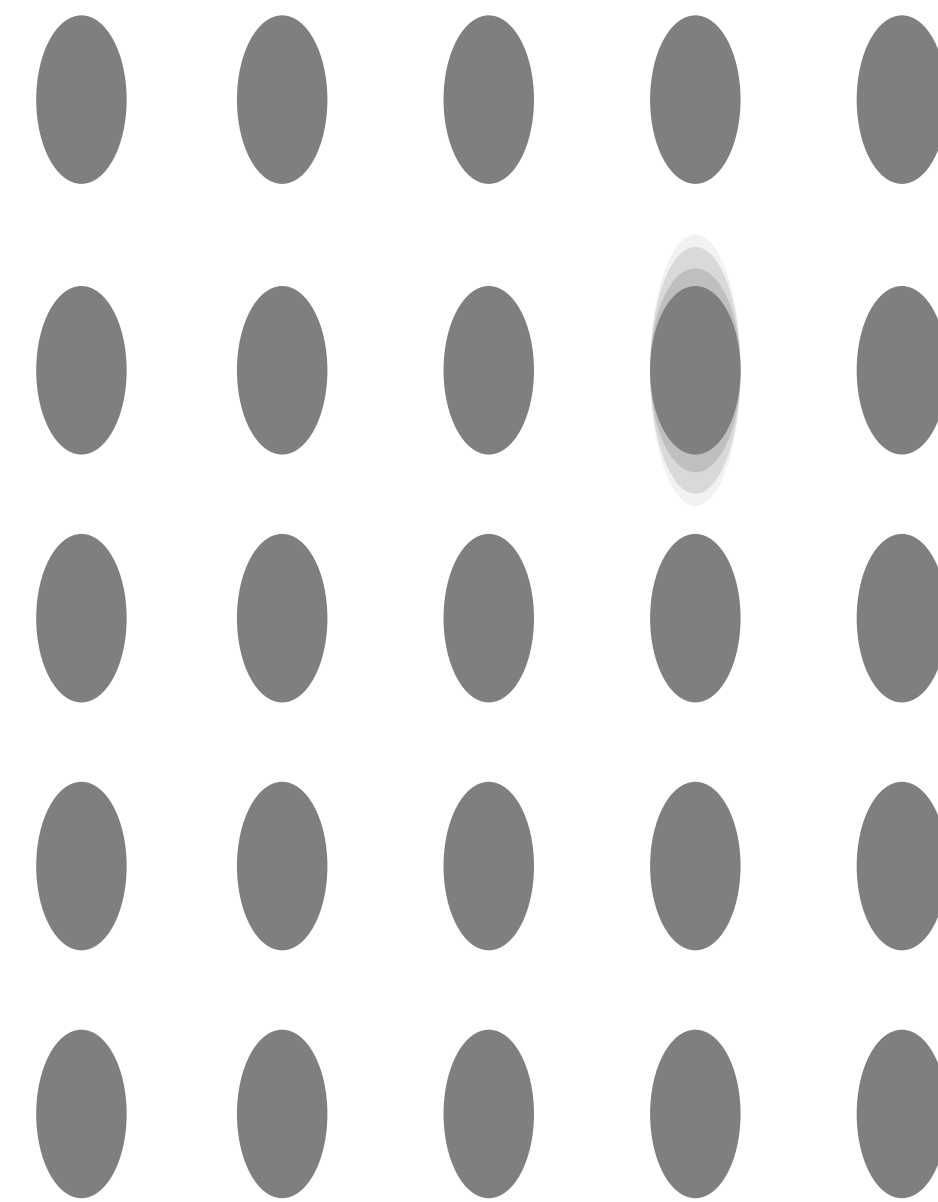
Luminosity



Hue



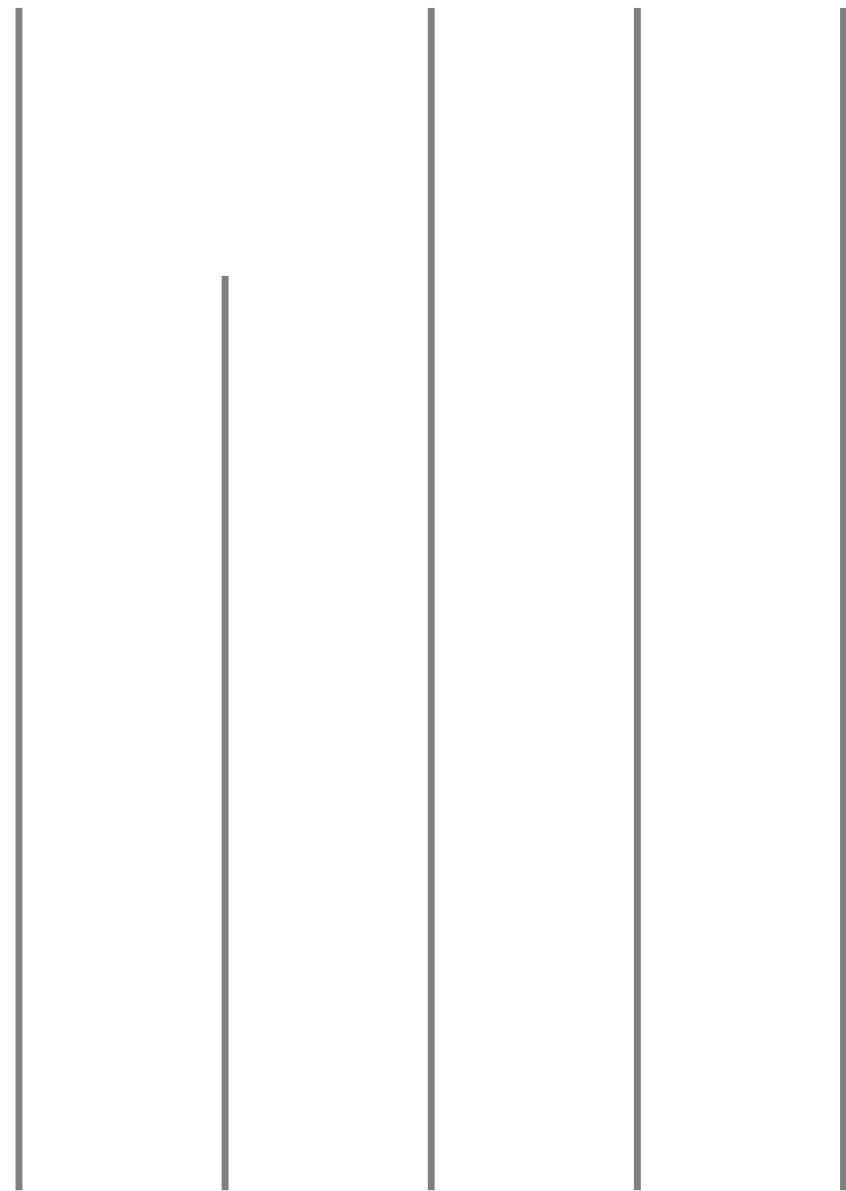
Shape



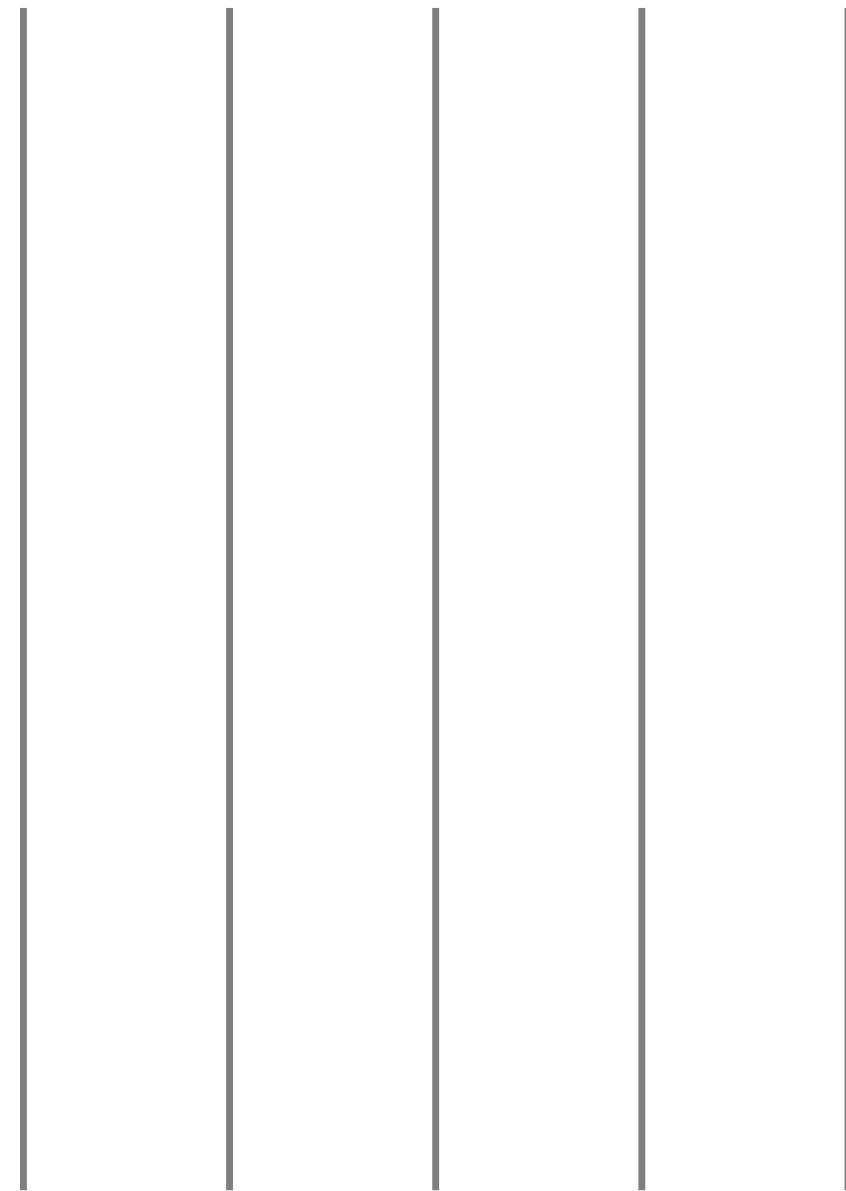
Motion

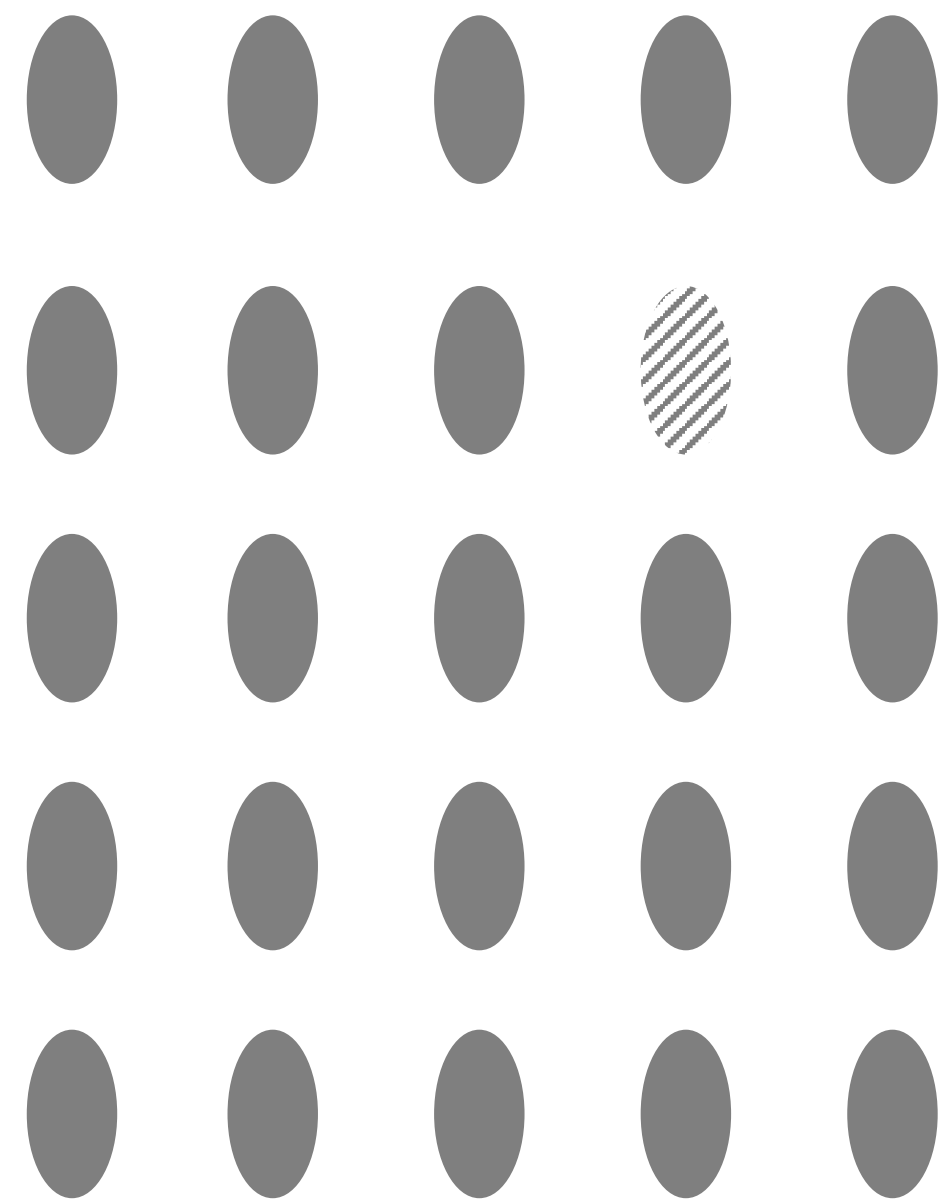


Line Length

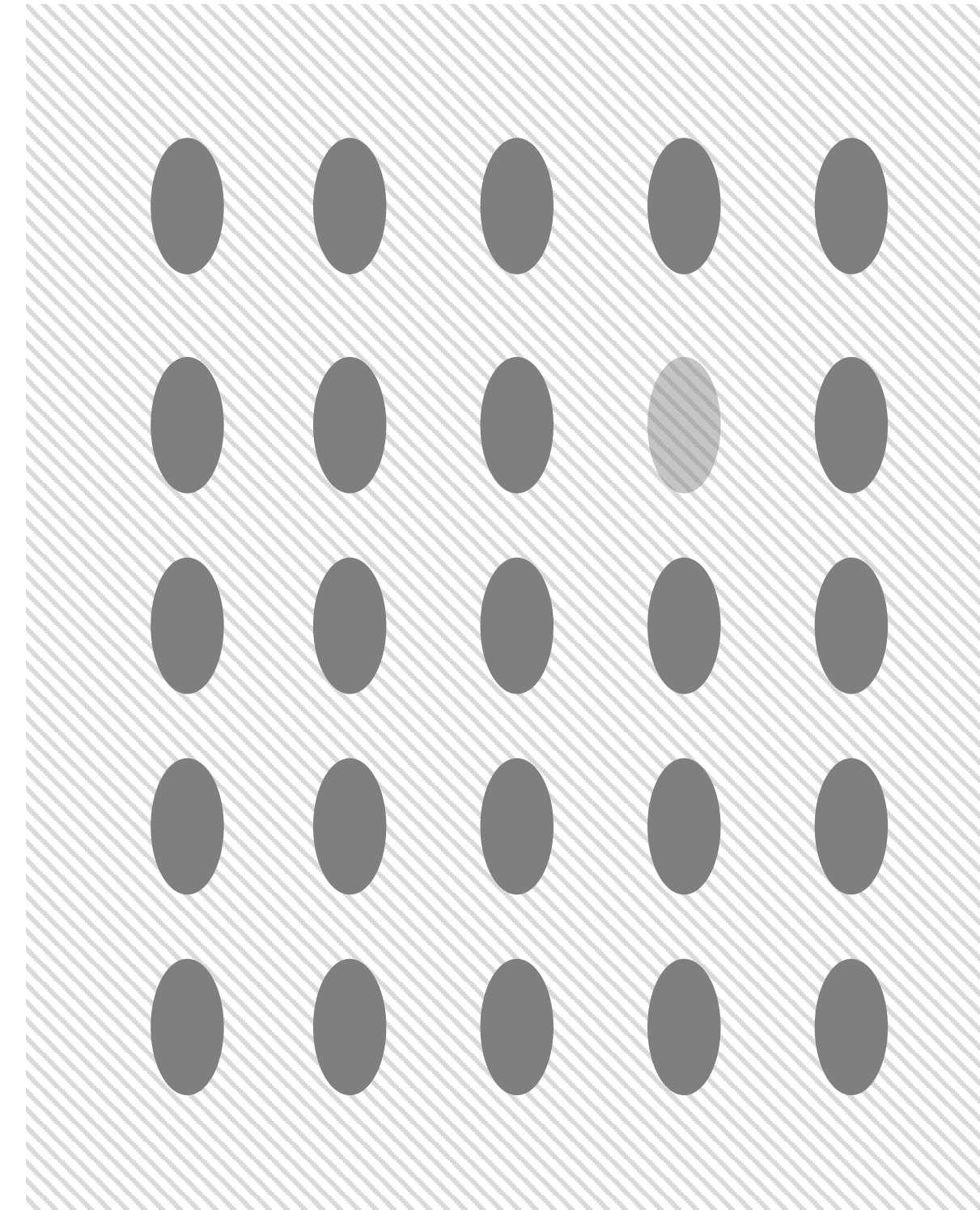


Line Width

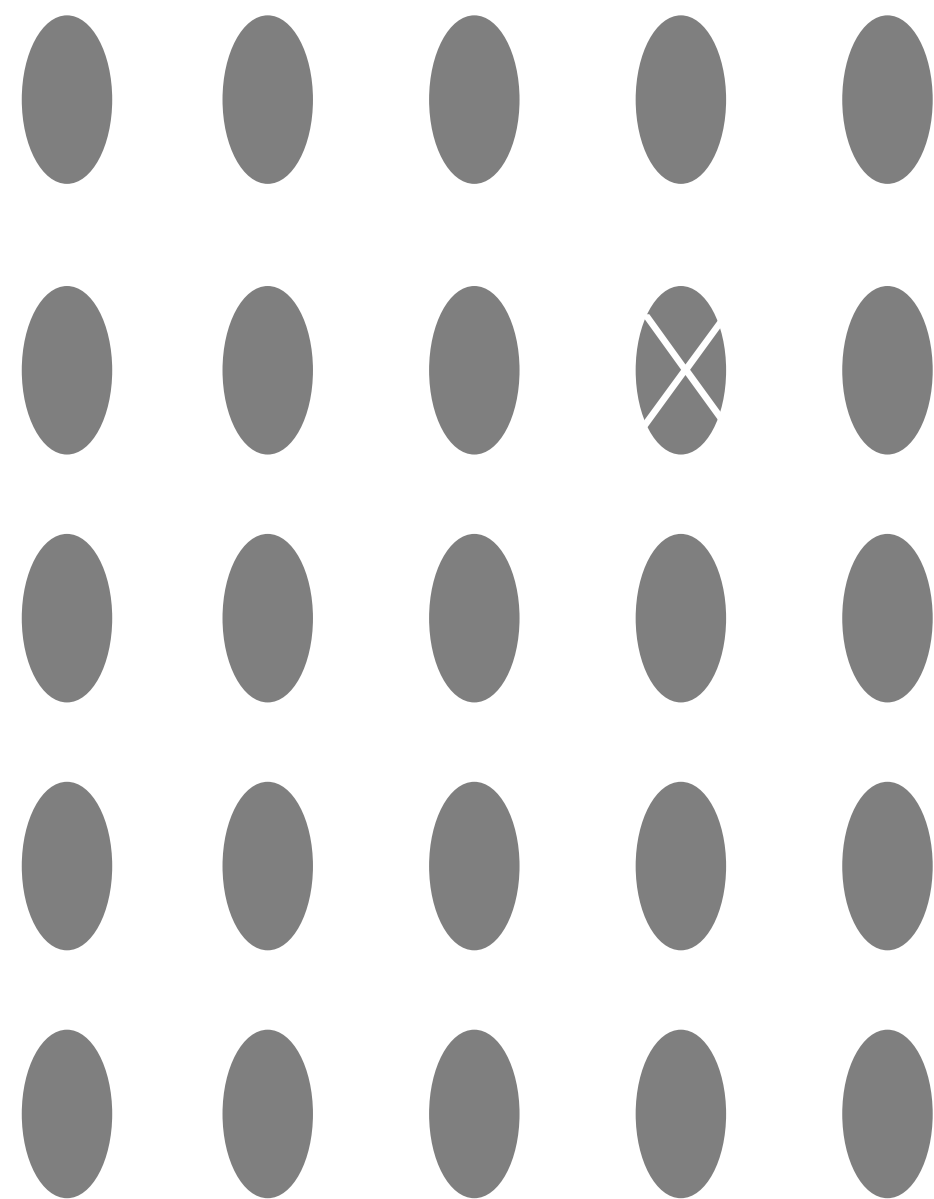




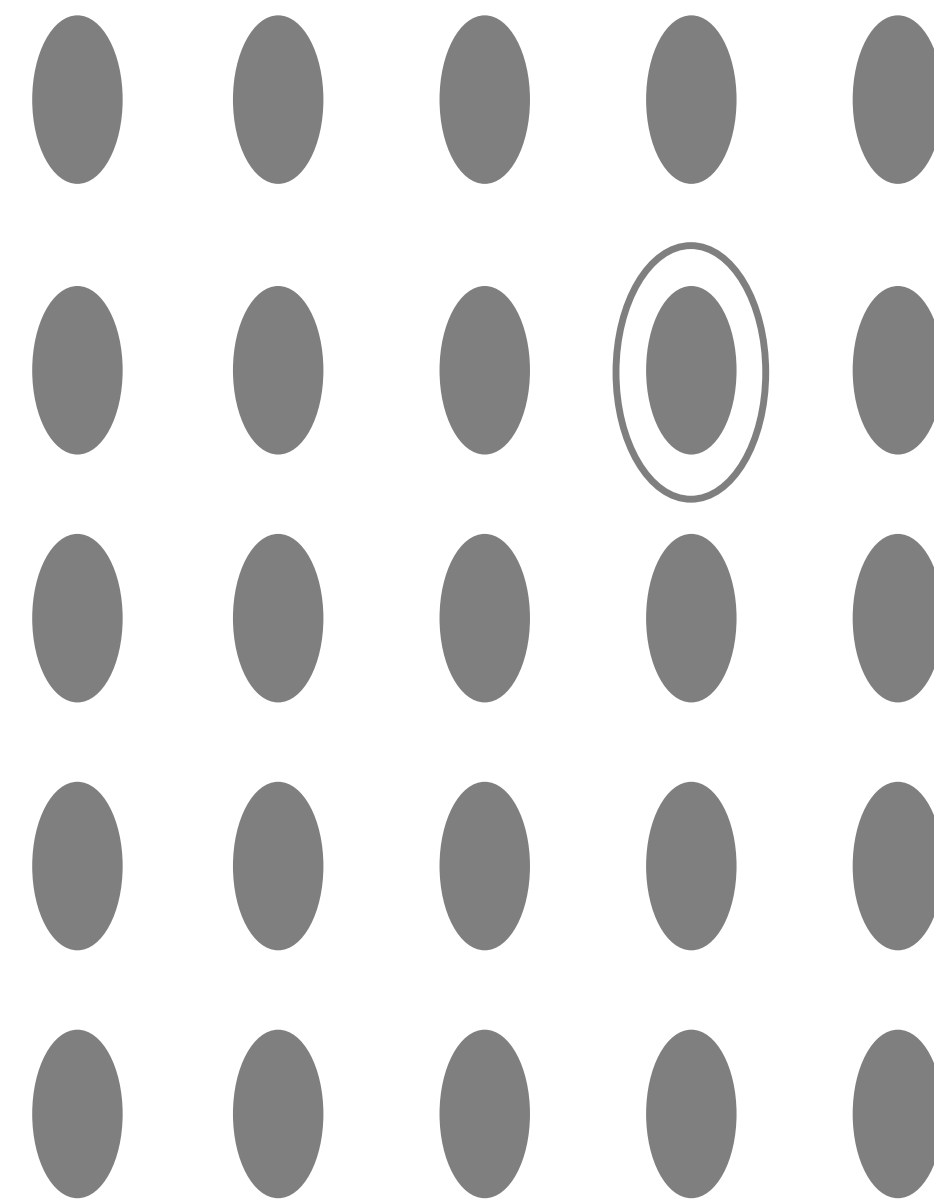
Texture



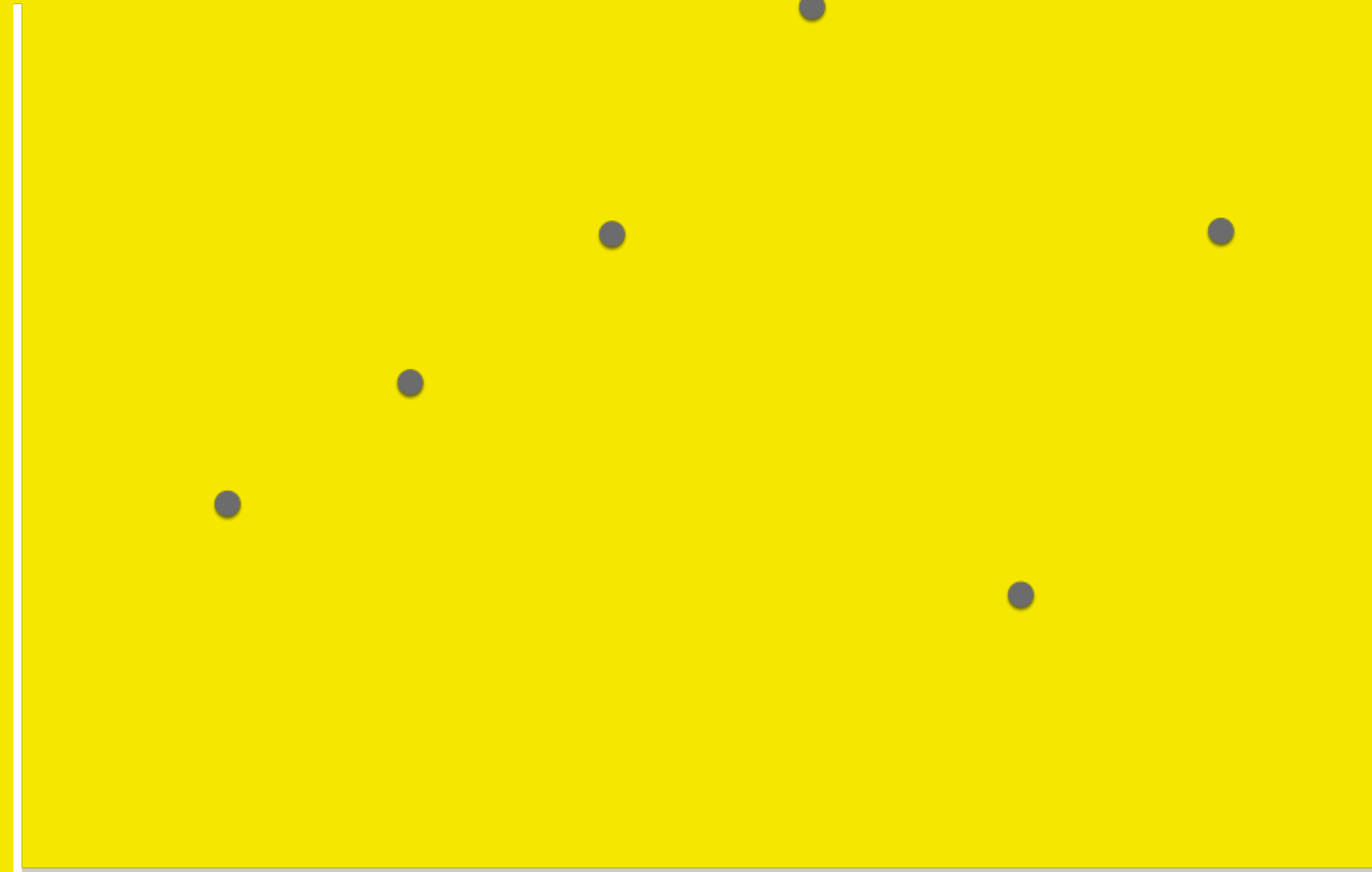
Transparency



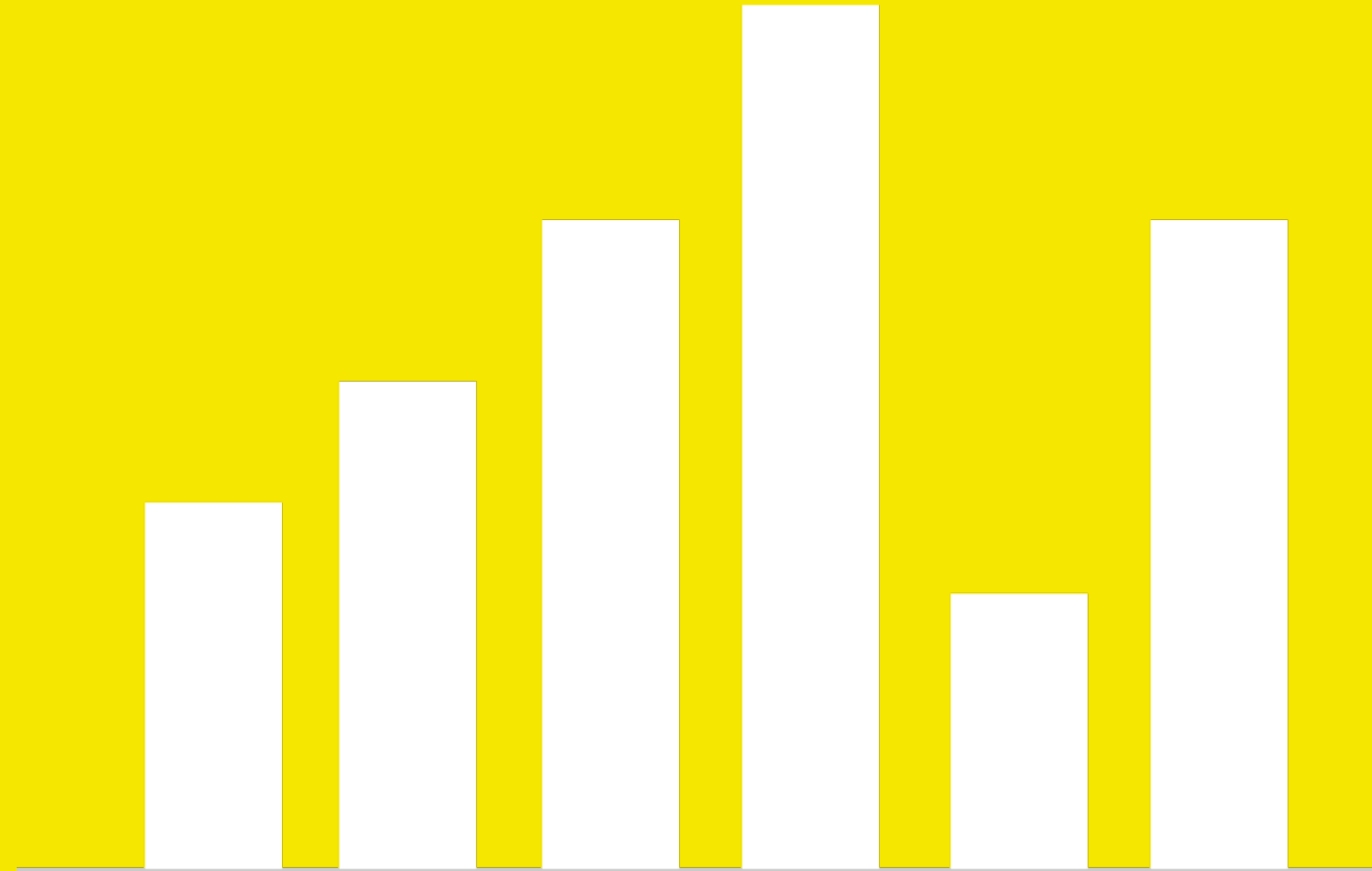
Markings



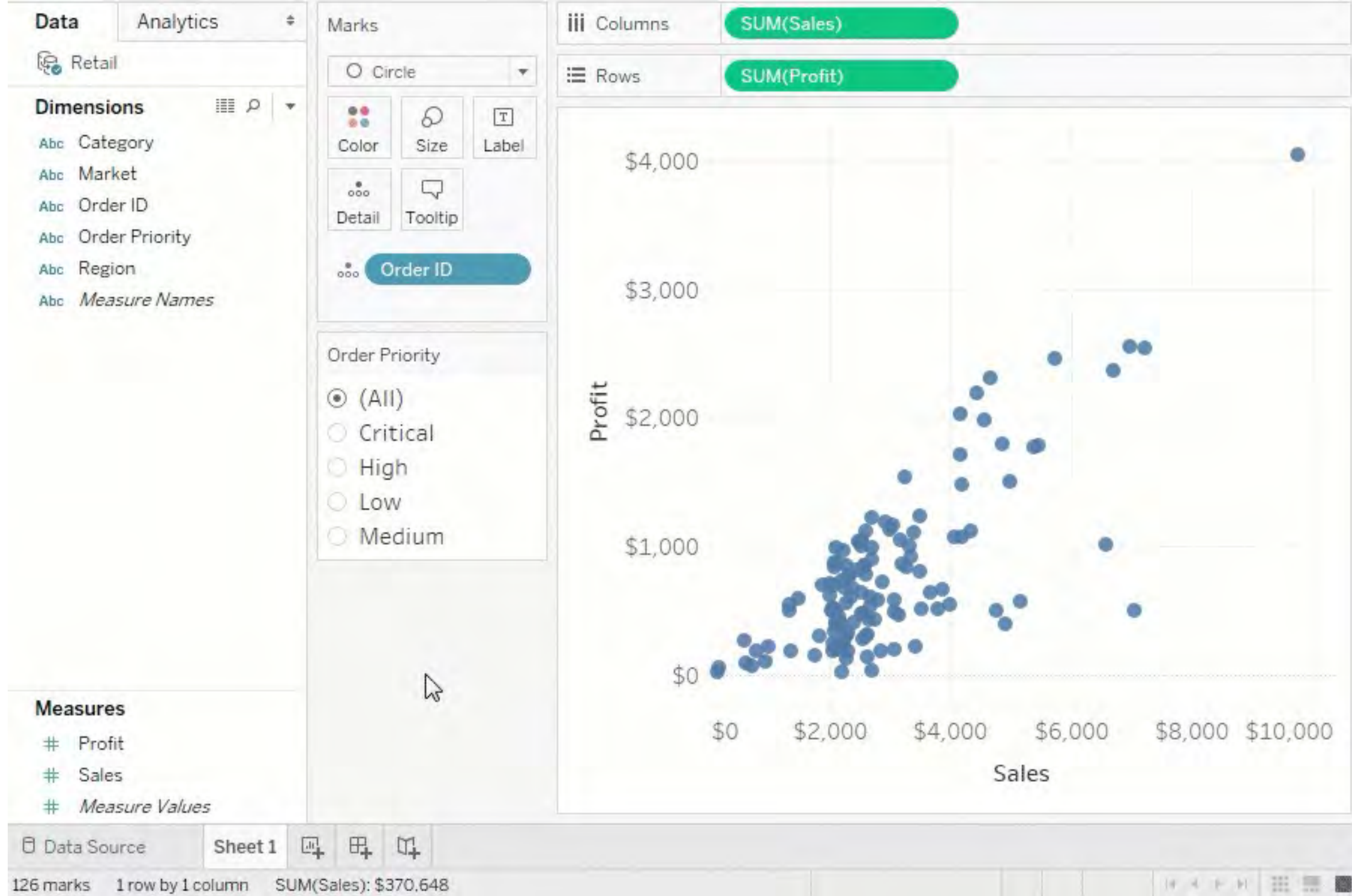
Enclosure



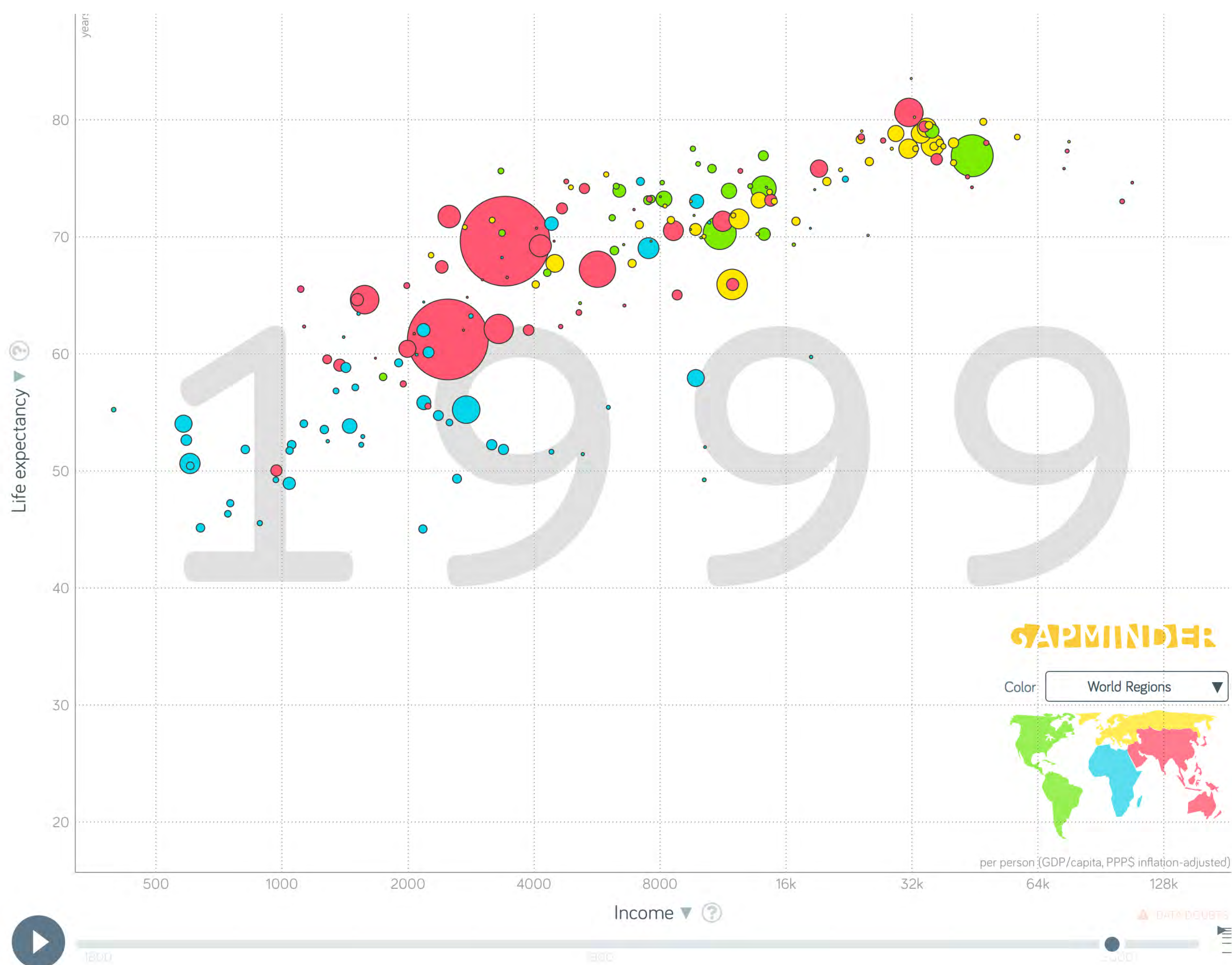




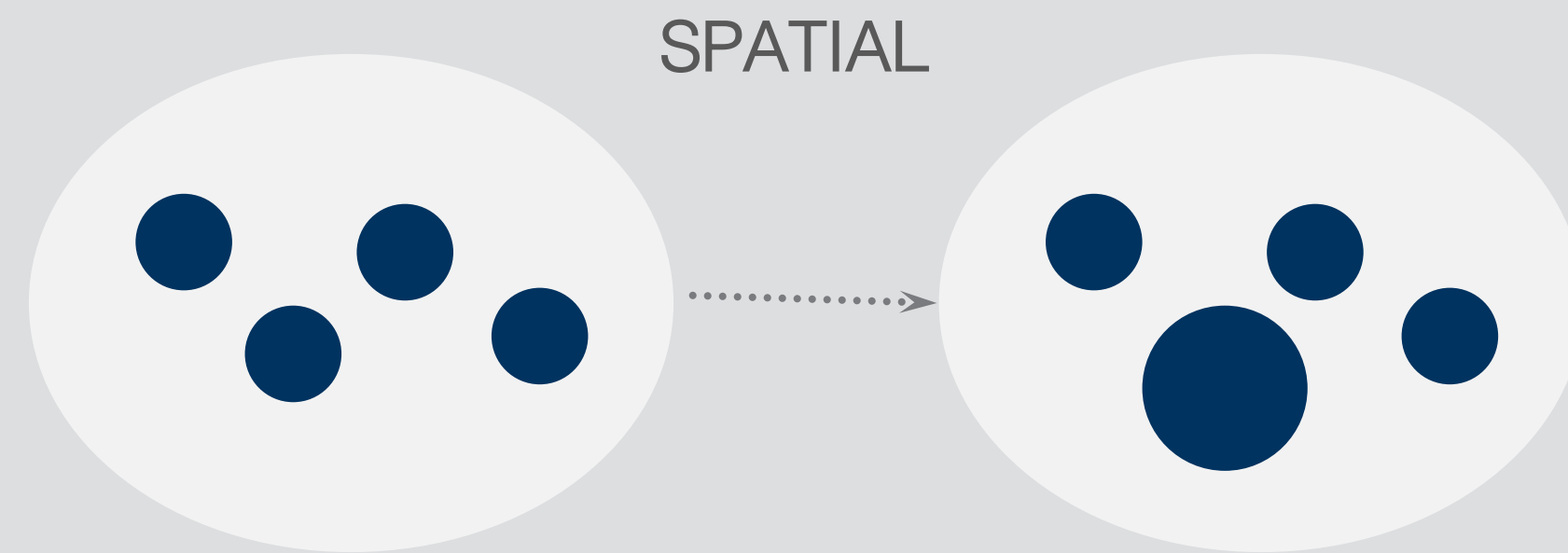
HOW DO WE REPRESENT DATA?



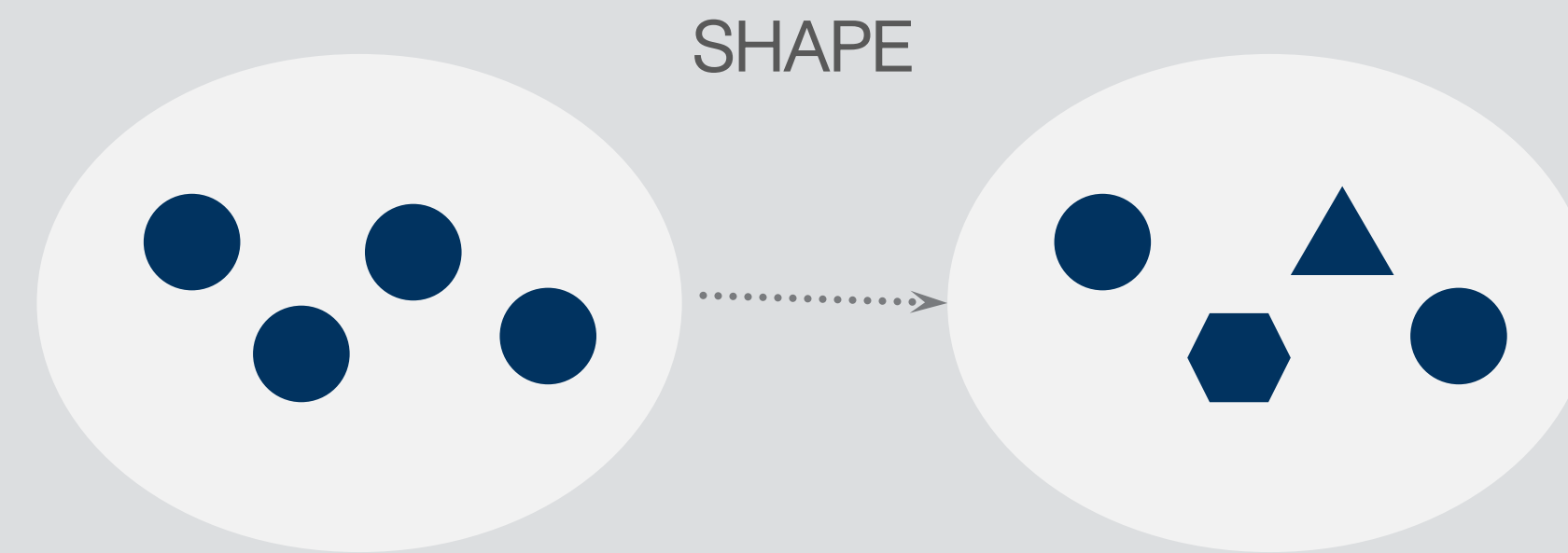
TABLEAU



GAPMINDER

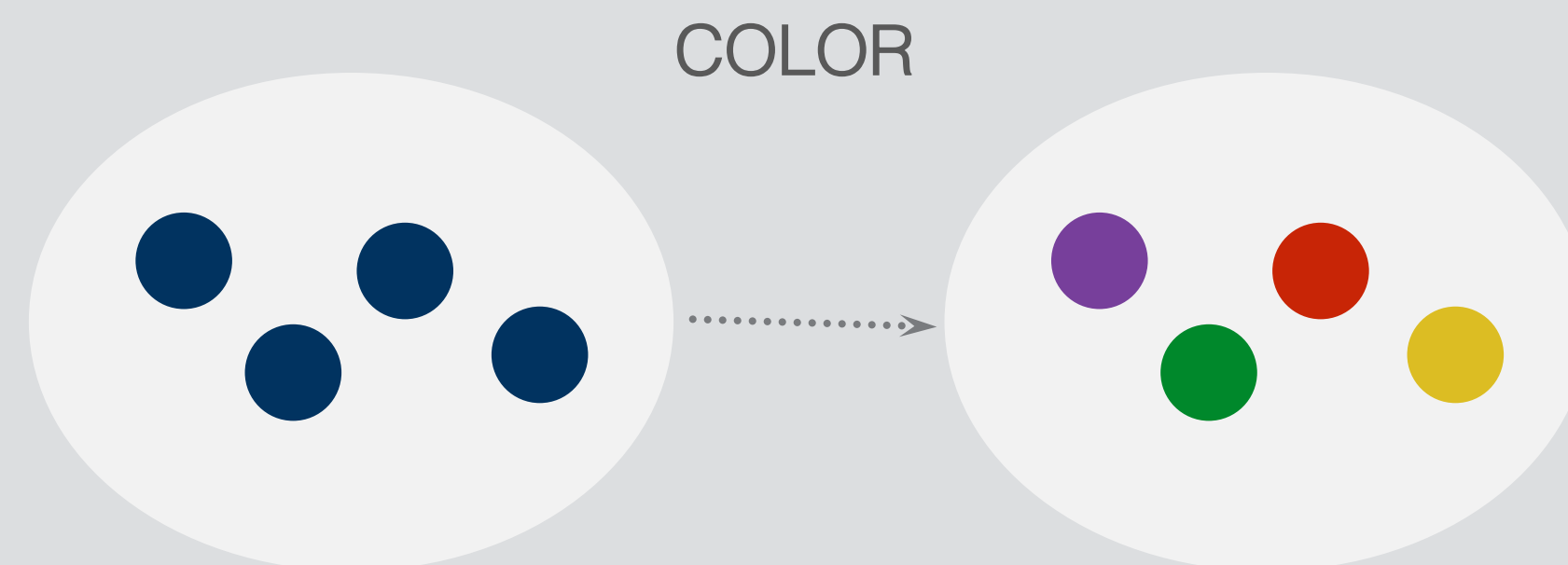


position | scale | orientation

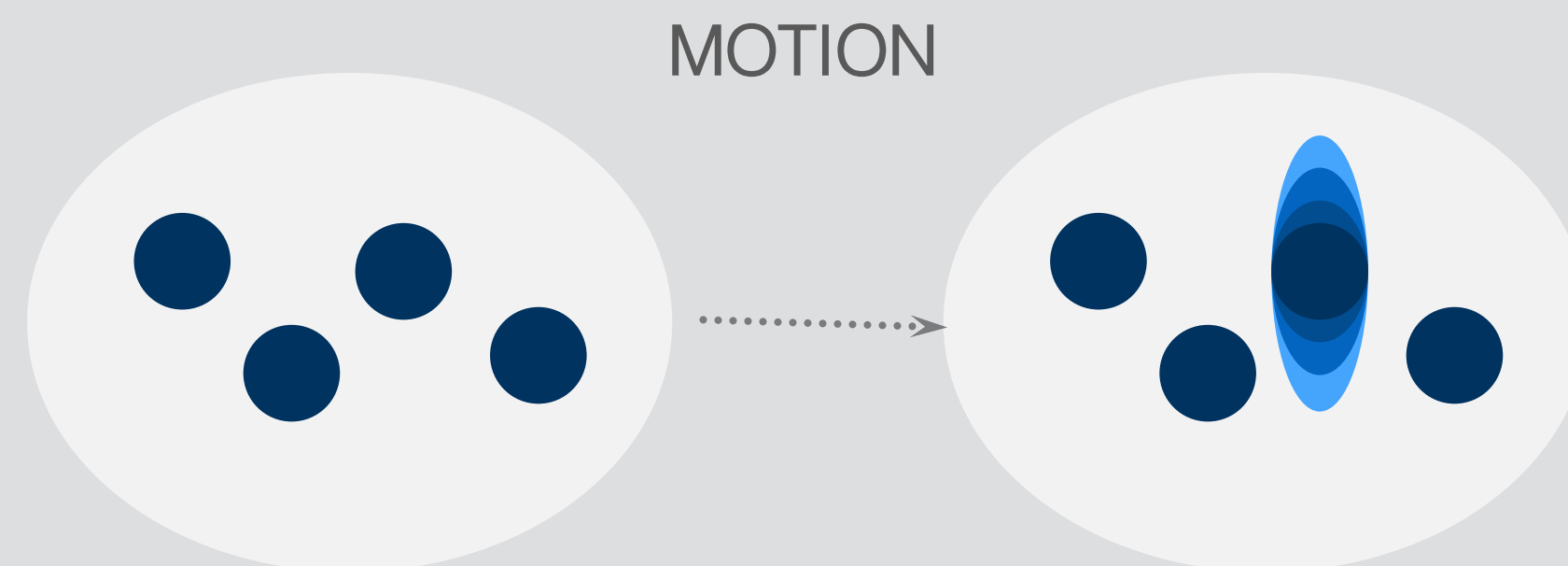


distinctive glyphs | bumps | points | whiskers

BASIC DATA ENCODING

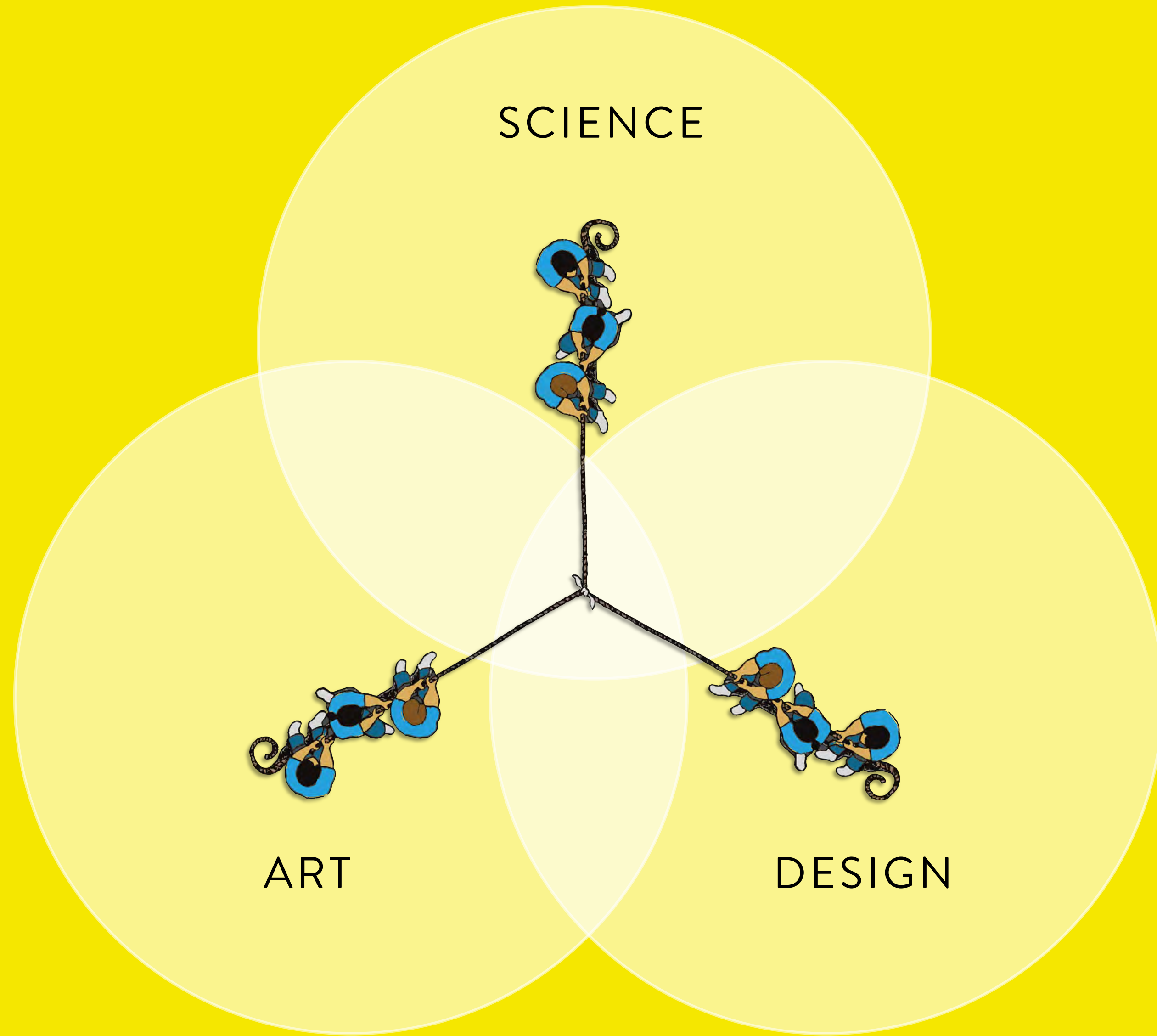


luminosity | hue | saturation | texture



vibration | rotation | deformation

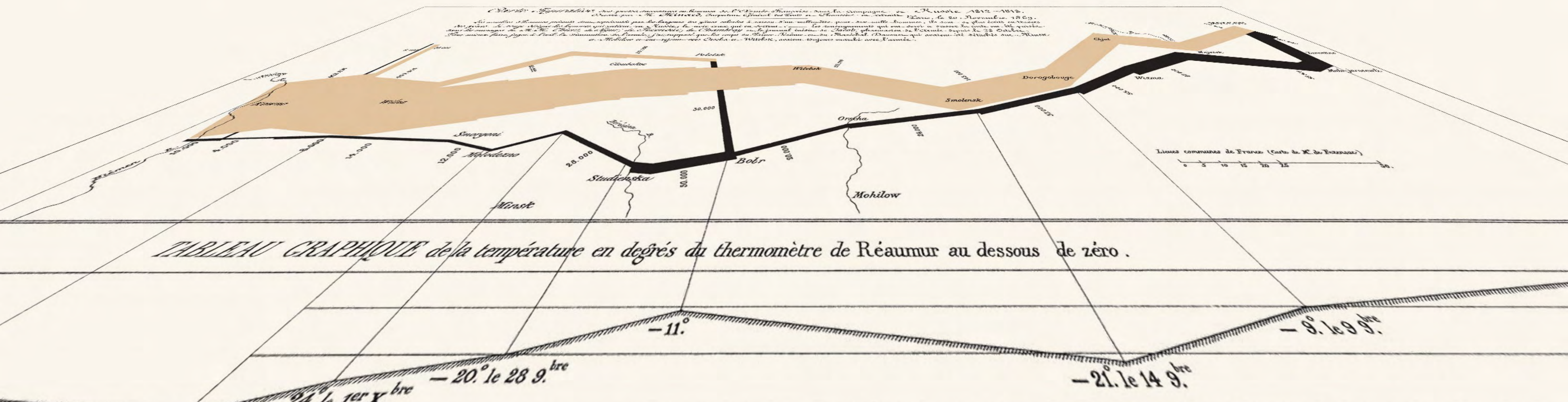
WHY REPRESENT DATA?



ED DWARDED
TRUFFLE

“Every single pixel should testify directly to content.”

—Edward Tufte



Carte Figurative des pertes successives en hommes de l'Armée Française dans la campagne de Russie 1812-1813.

Dressée par M. Minard, Inspecteur Général des Ponts et Chaussées en retraite. Paris, le 20 Novembre 1869.

Les nombres d'hommes présents sont représentés par les largeurs des zones colorées à raison d'un millimètre pour dix mille hommes; ils sont de plus écrits en travers des zones. Le rouge désigne les hommes qui entrent en Russie, le noir ceux qui en sortent. — Les renseignements qui ont servi à dresser la carte ont été puisés dans les ouvrages de M. M. Thiers, de Ségur, de Fezensac, de Chambray et le journal inédit de Jacob, pharmacien de l'Armée depuis le 28 Octobre.

Pour mieux faire juger à l'œil la diminution de l'armée, j'ai supposé que les corps du Prince Jérôme et du Maréchal Davout qui avaient été détachés sur Minsk et Mohilow et ont rejoint vers Orscha et Witebsk, avaient toujours marché avec l'armée.

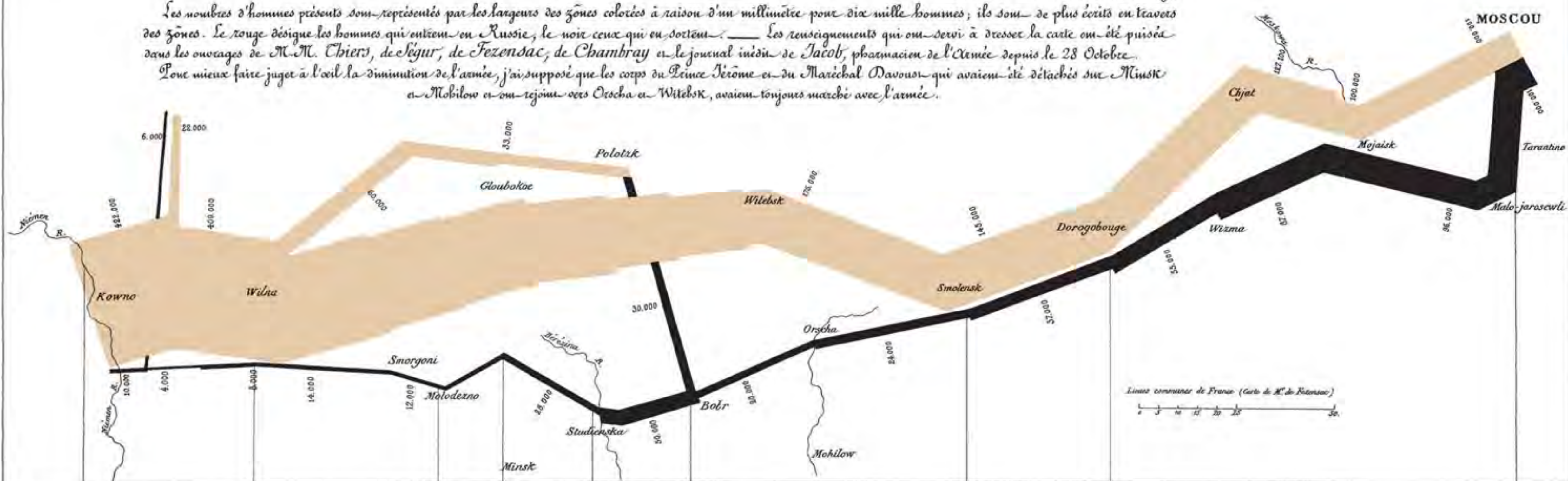
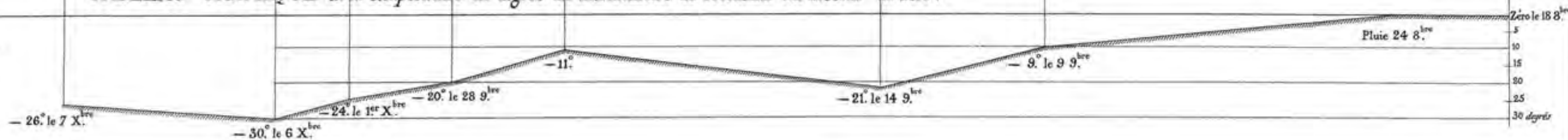


TABLEAU GRAPHIQUE de la température en degrés du thermomètre de Réaumur au dessous de zéro.

Les Cosaques passent au galop le Niemen gelé.



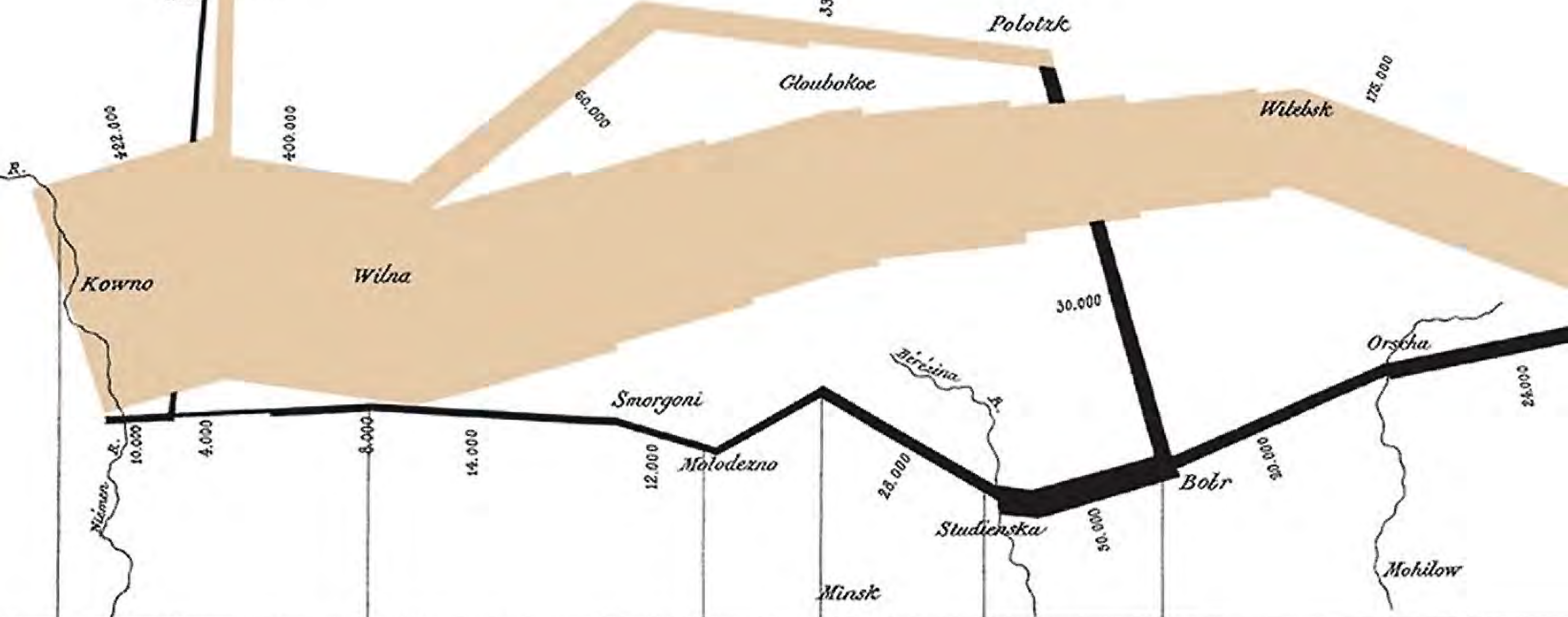
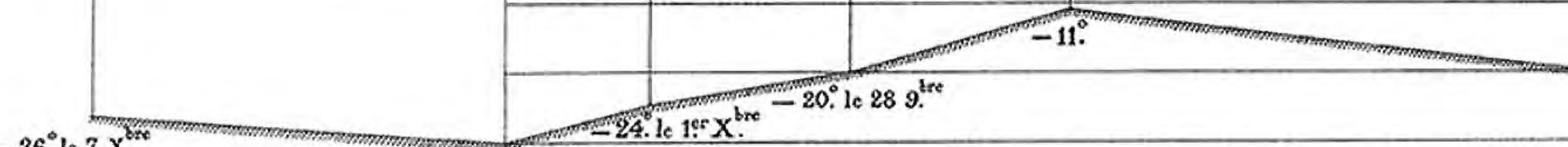


TABLEAU GRAPHIQUE de la température en degrés du thermomètre de Réaumur au de

Cosaques passent au galop
sur la glace gelée.



FLORENCE
NIGHTINGALE

“To affect through the eyes what we fail to convey to the public through their word-proof ears.” — Florence Nightingale

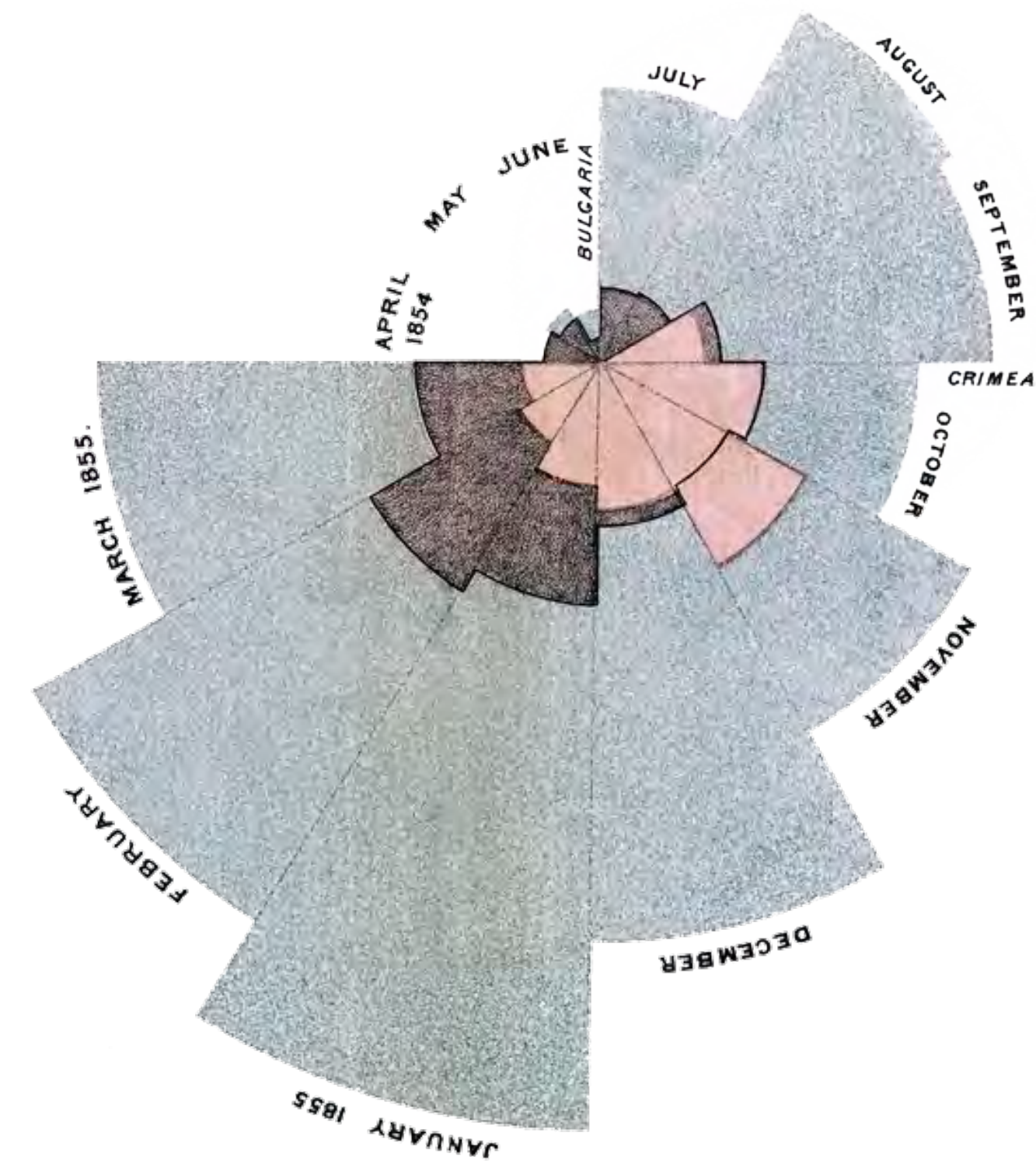
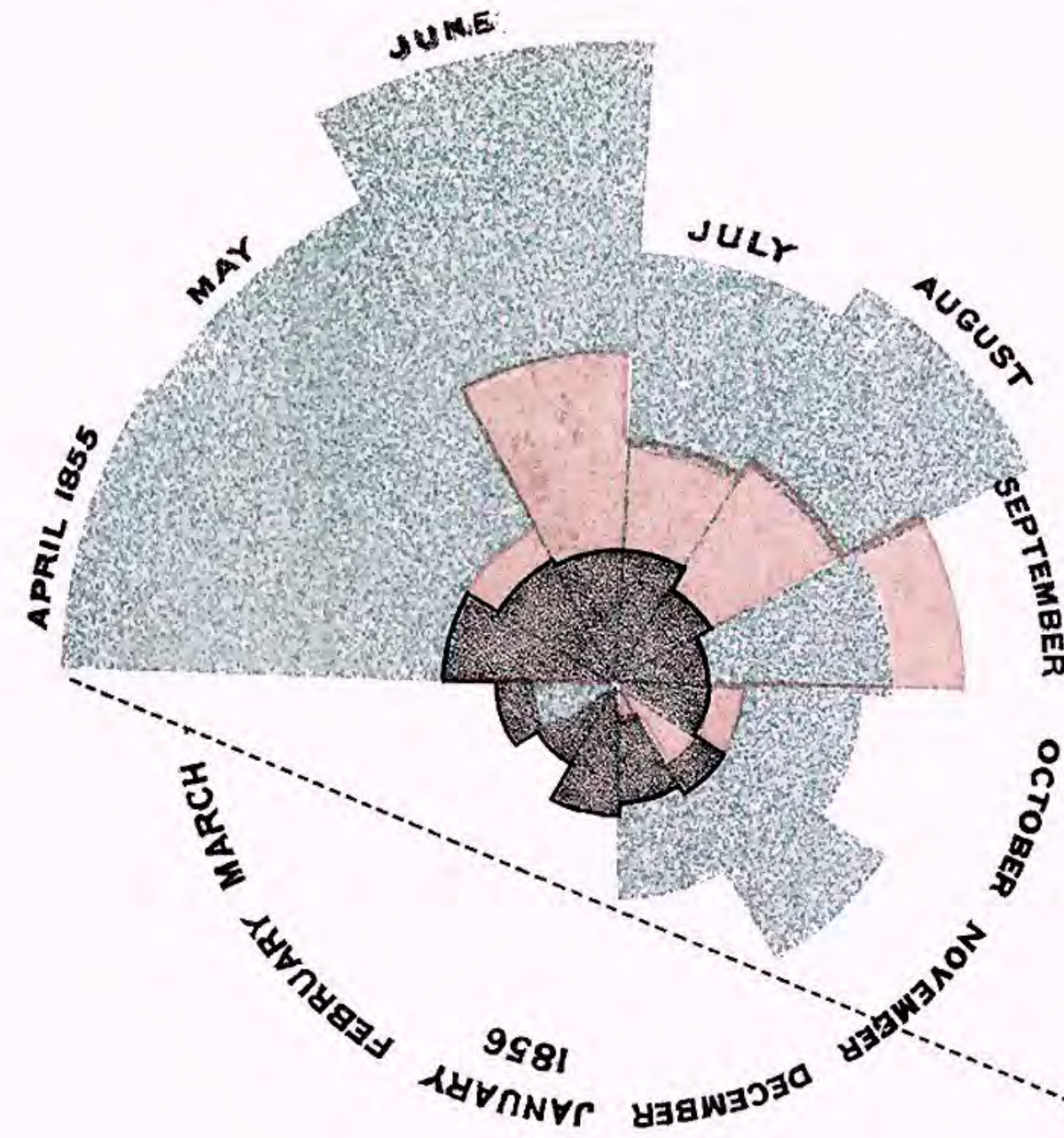
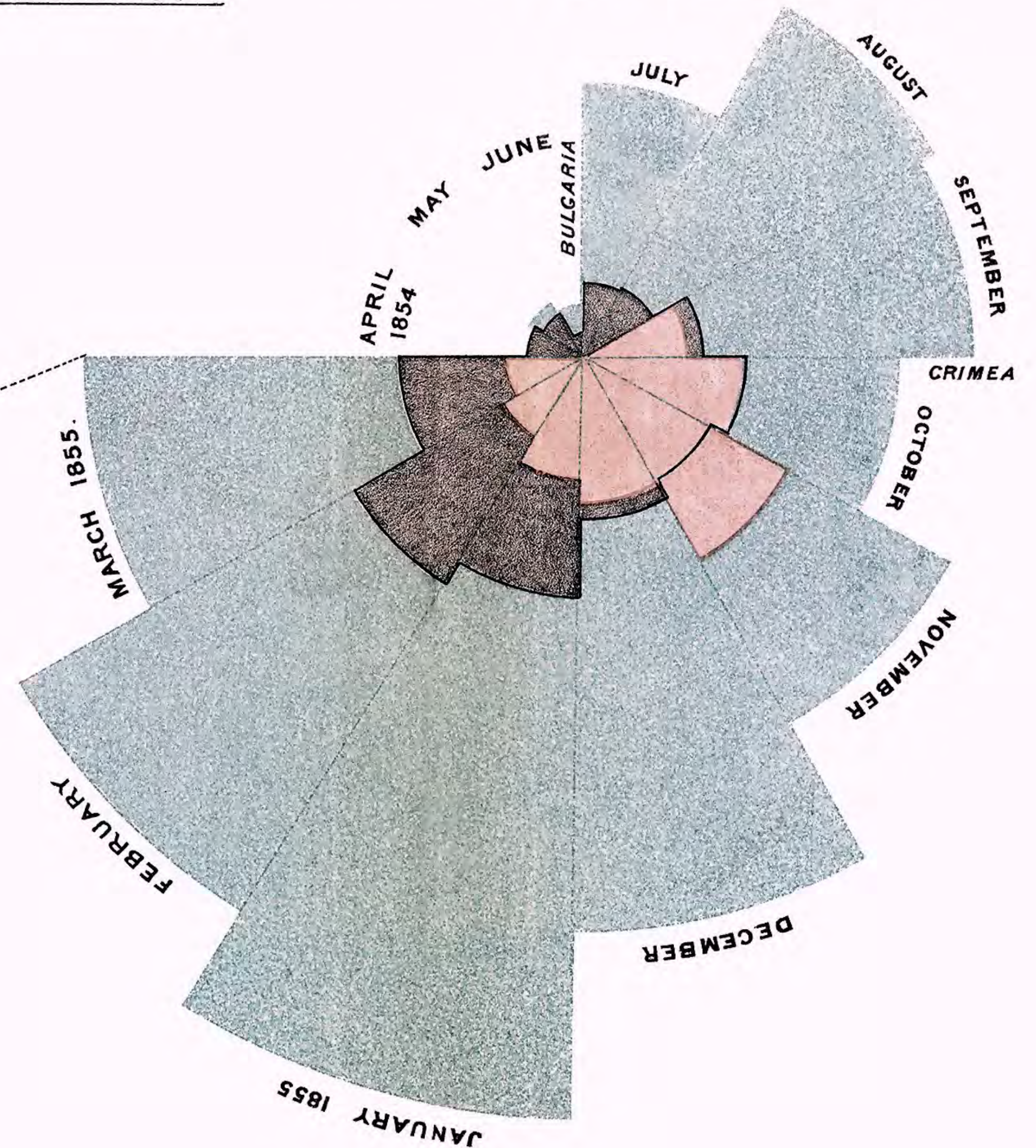


DIAGRAM OF THE CAUSES OF MORTALITY IN THE ARMY IN THE EAST.

2.
APRIL 1855 TO MARCH 1856.



1.
APRIL 1854 TO MARCH 1855.



The Areas of the blue, red, & black wedges are each measured from the centre as the common vertex.

The blue wedges measured from the centre of the circle represent area for area the deaths from Preventible or Mitigable Zymotic diseases; the red wedges measured from the centre the deaths from wounds; & the black wedges measured from the centre the deaths from all other causes.

The black line across the red triangle in Nov'r 1854 marks the boundary of the deaths from all other causes during the month.

In October 1854, & April 1855; the black area coincides with the red; in January & February 1856, the blue coincides with the black.

The entire areas may be compared by following the blue, the red & the black lines enclosing them.

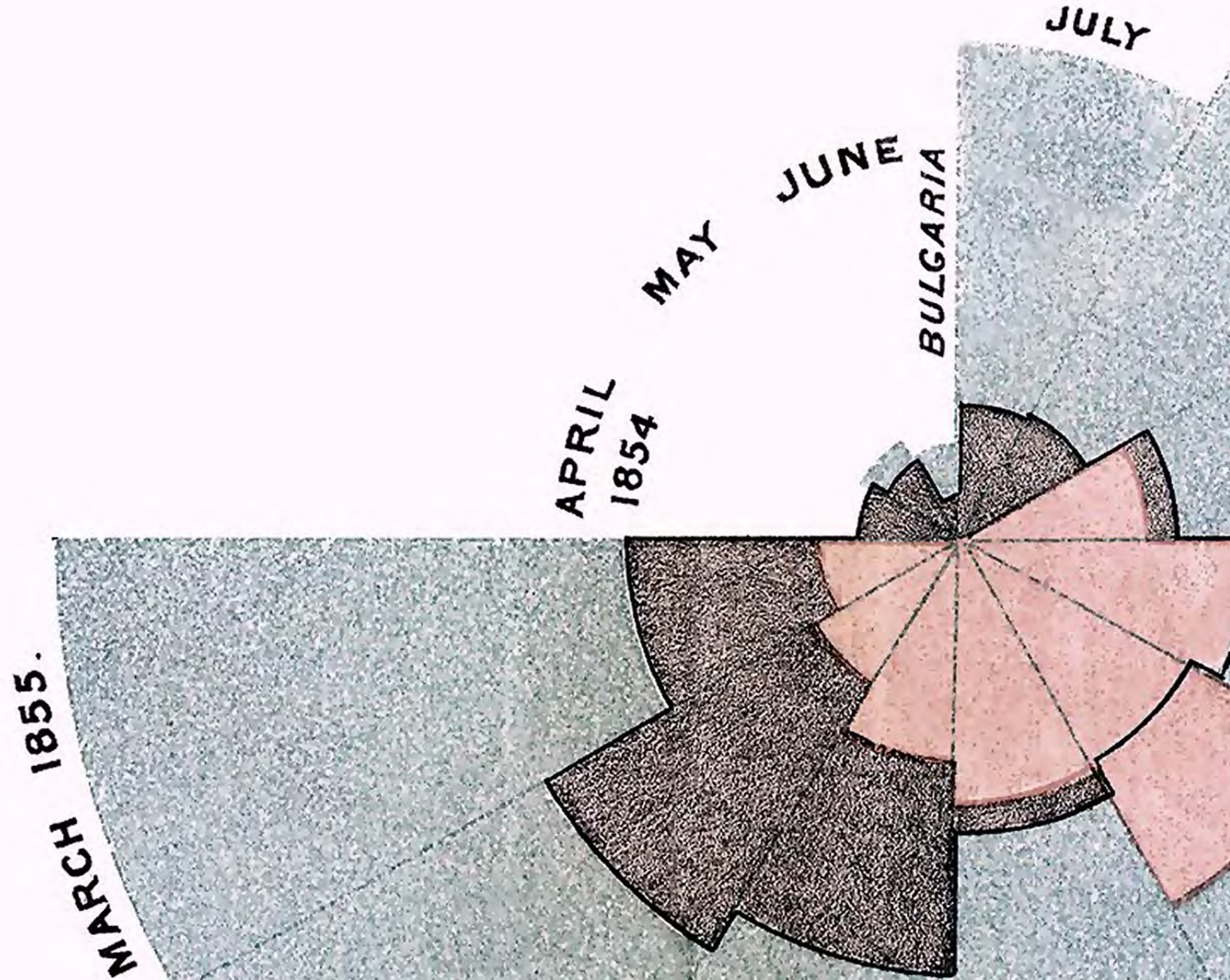
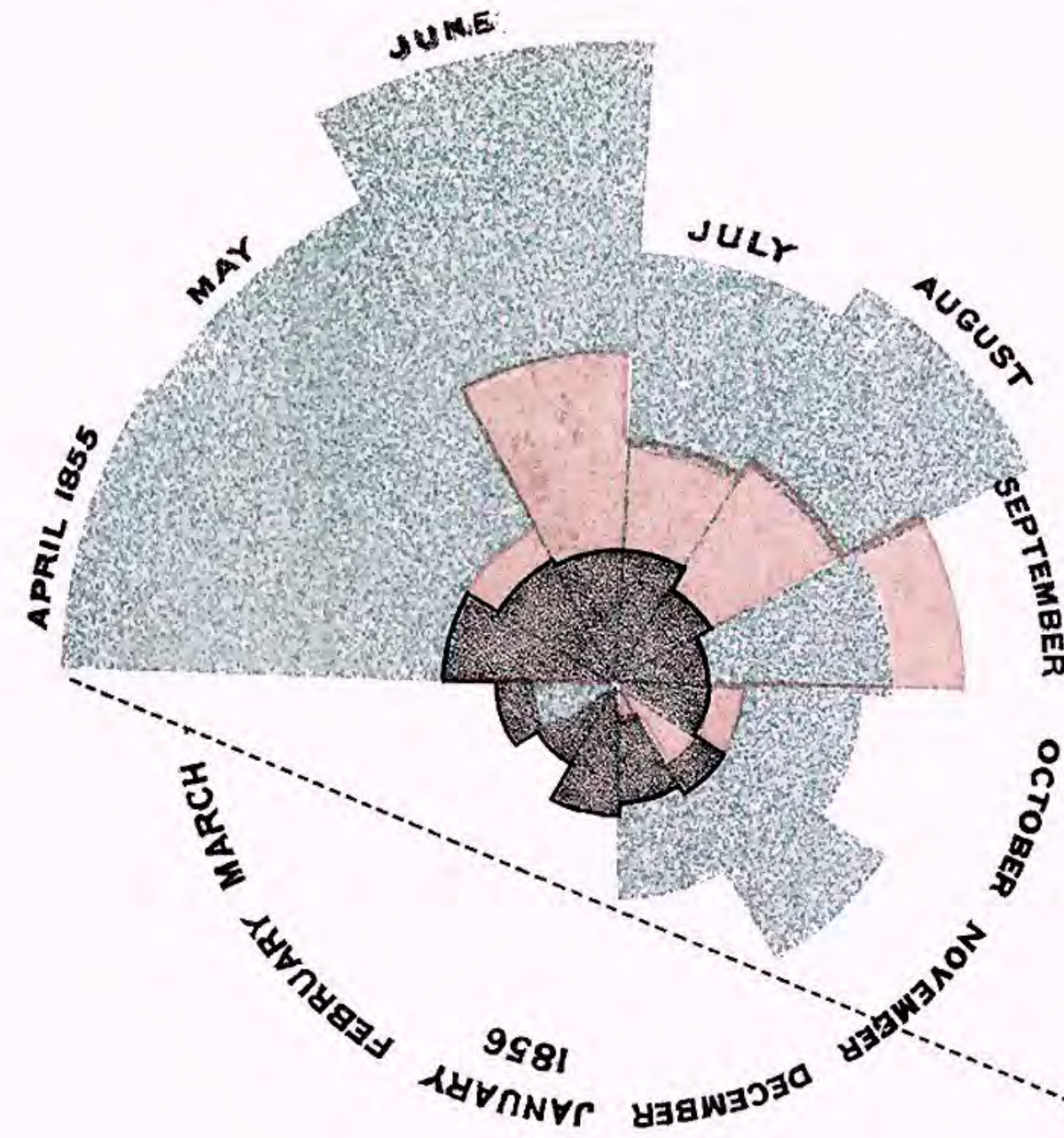
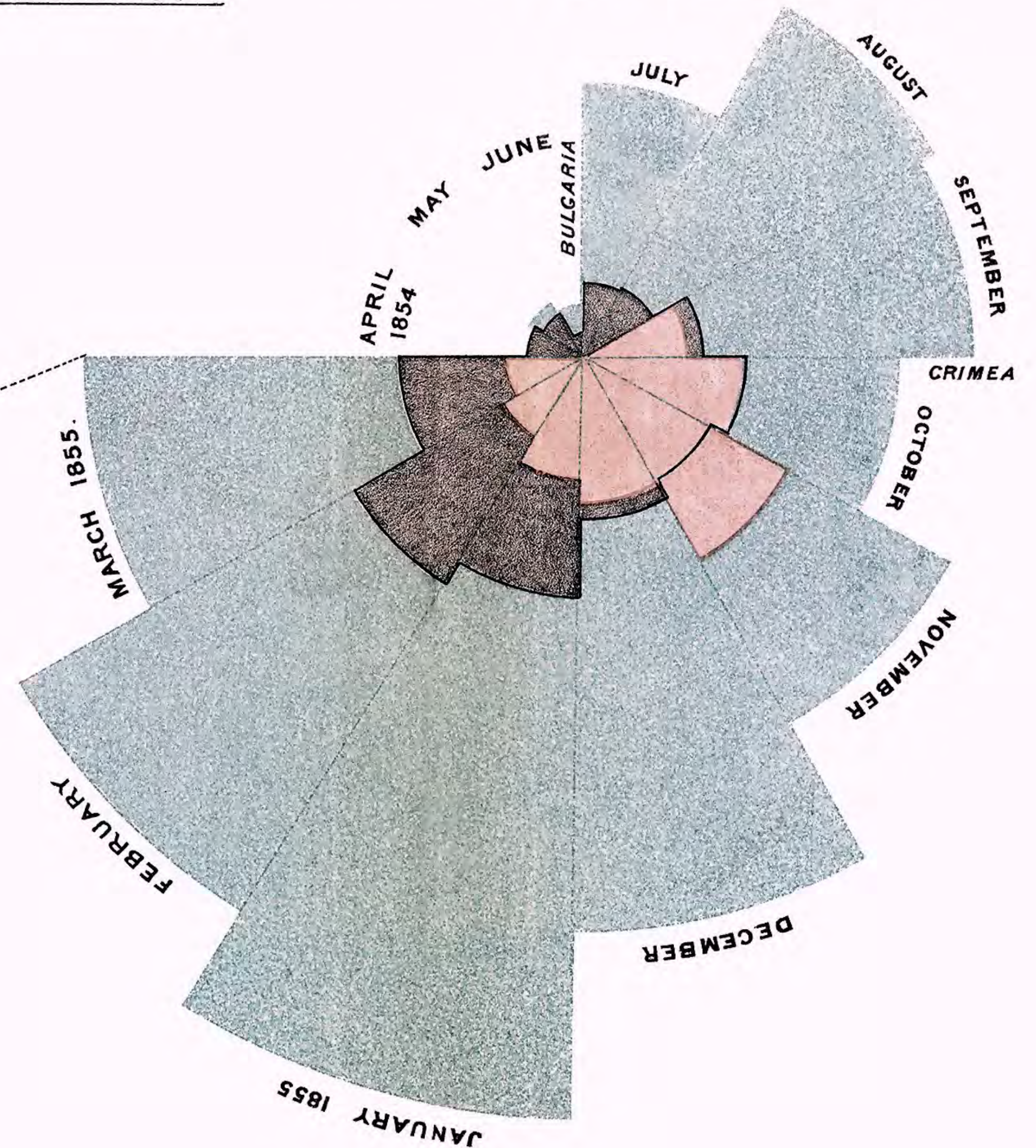


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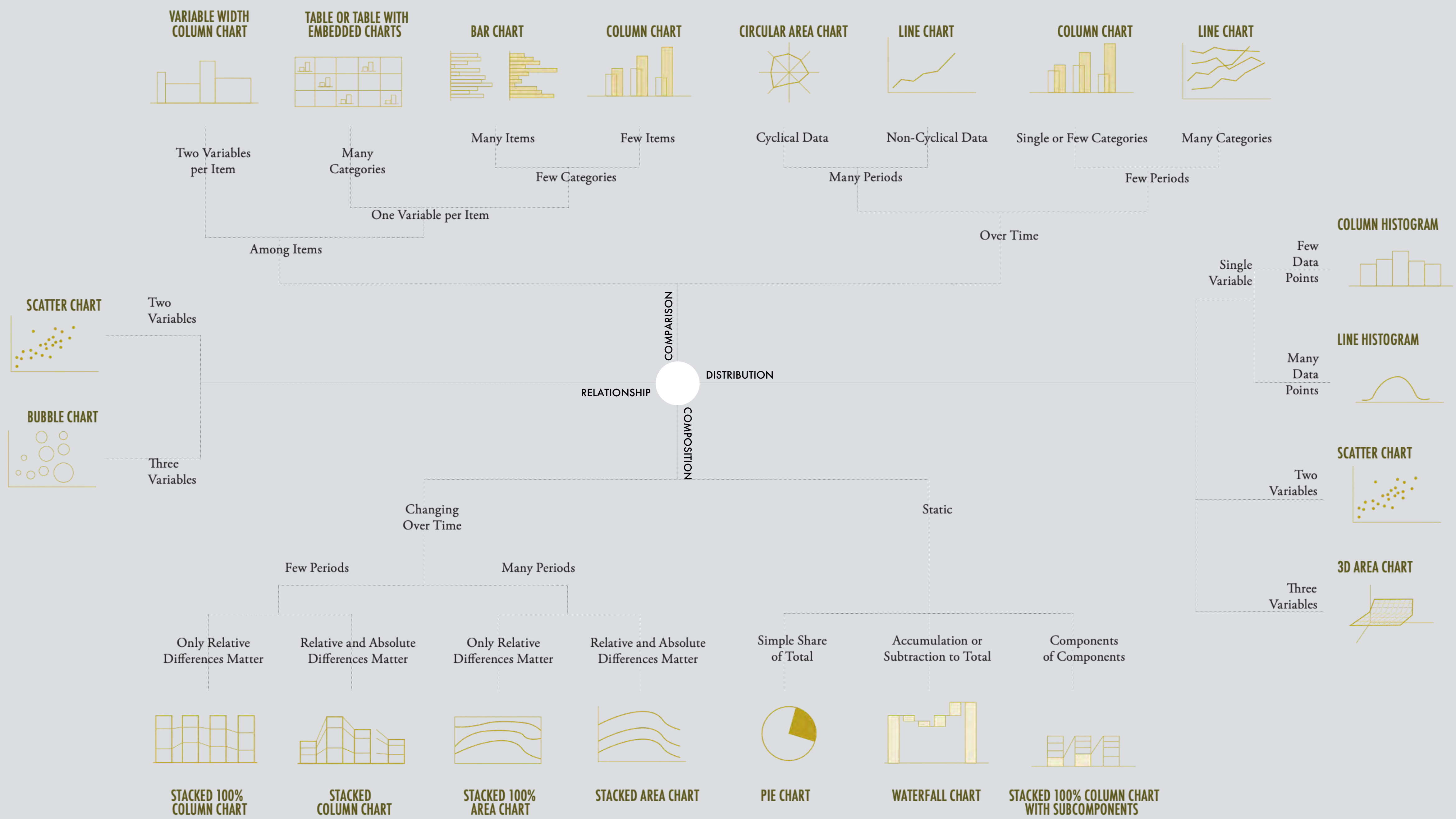
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PLOTS PLOTS PLOTS

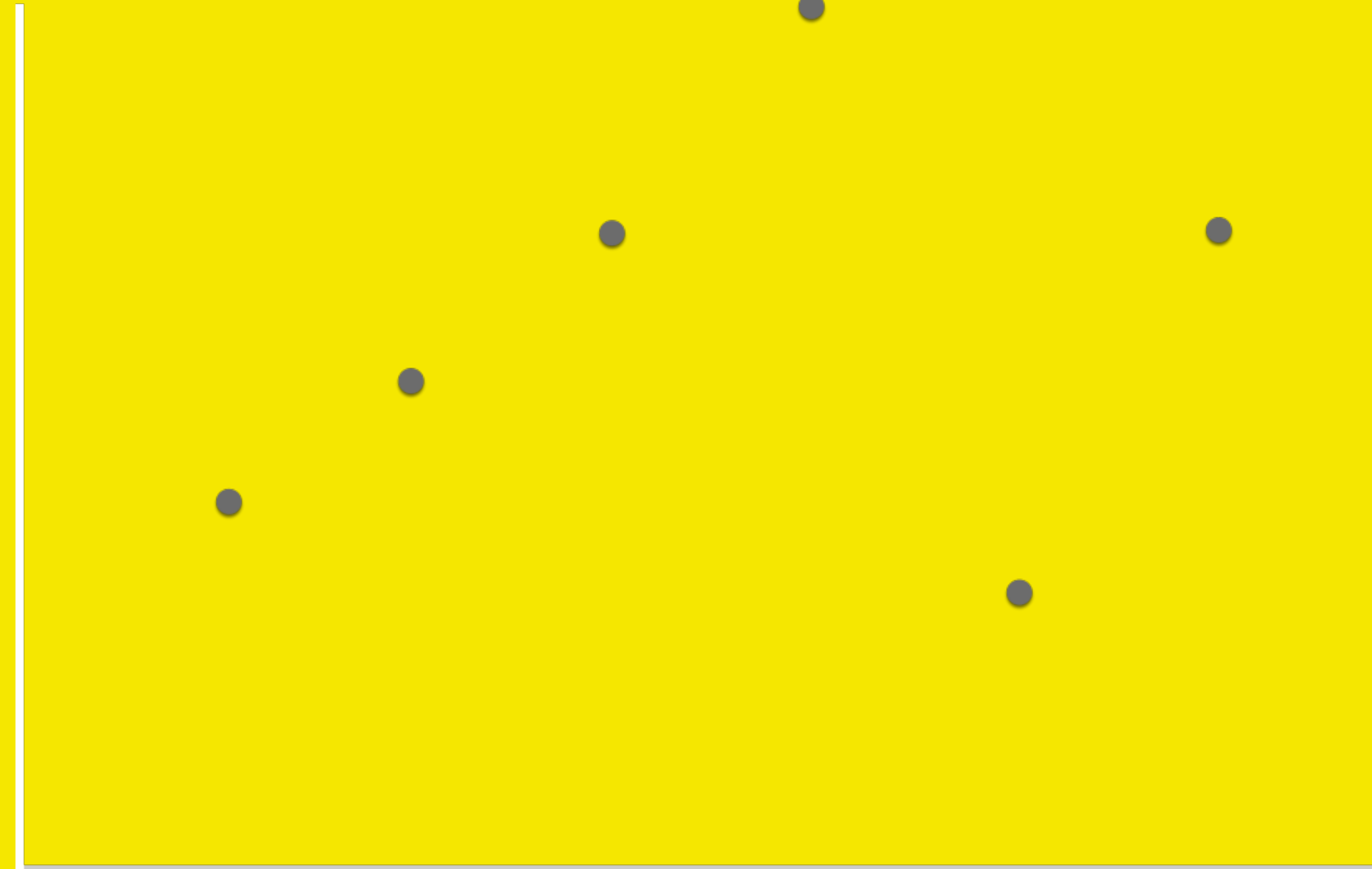


LAYERERS

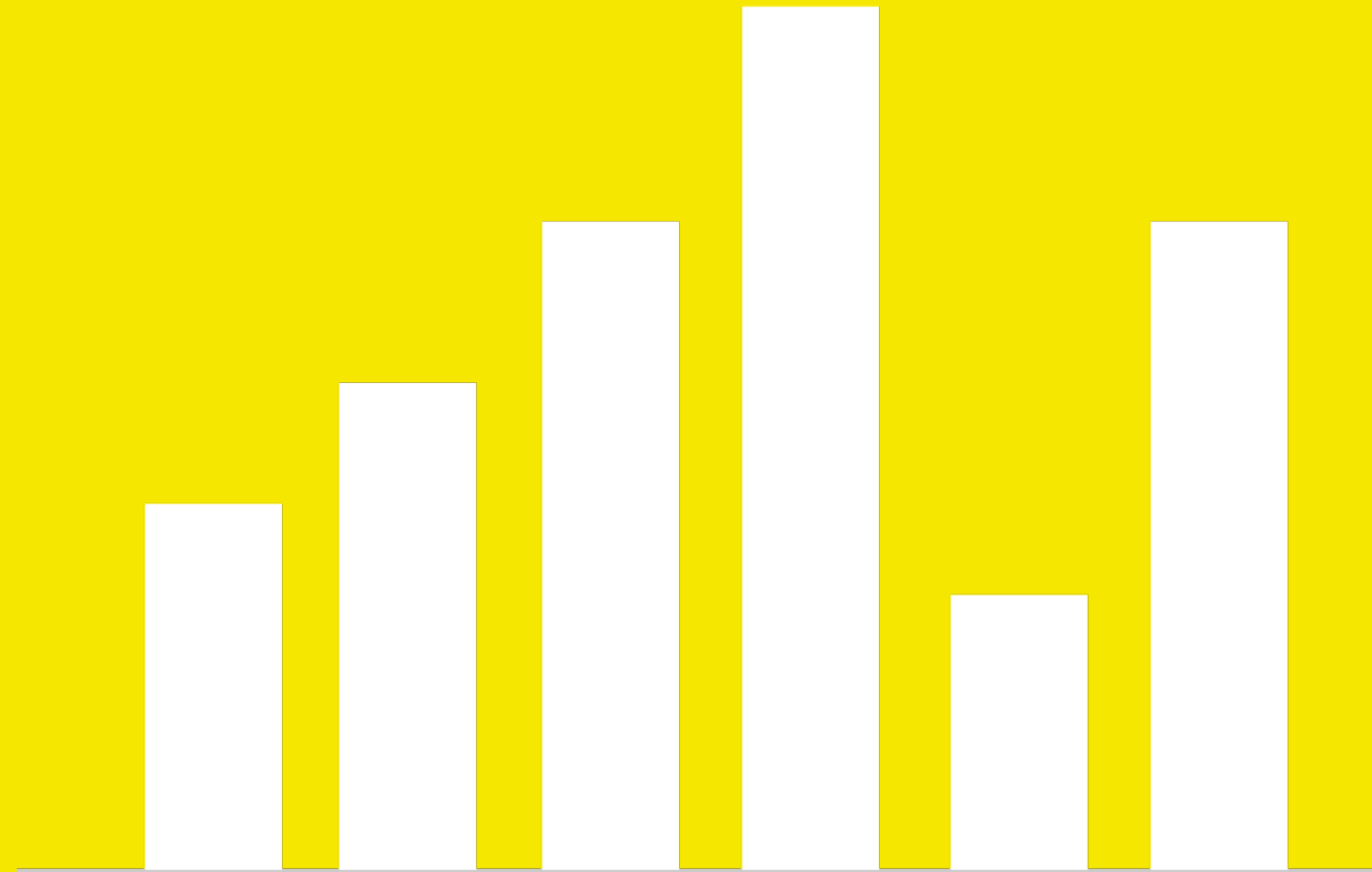
LAYERERS

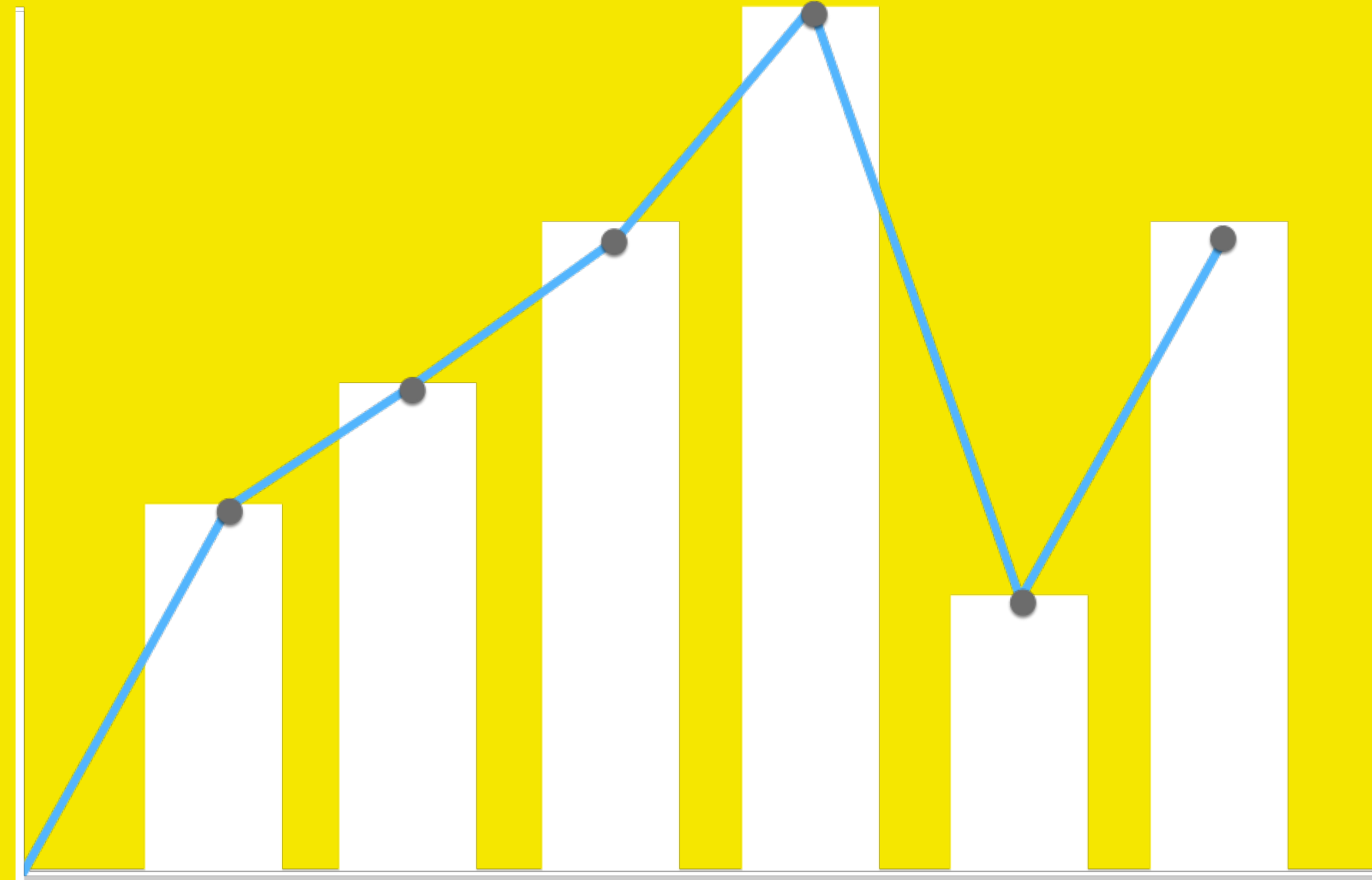
LAYERERS

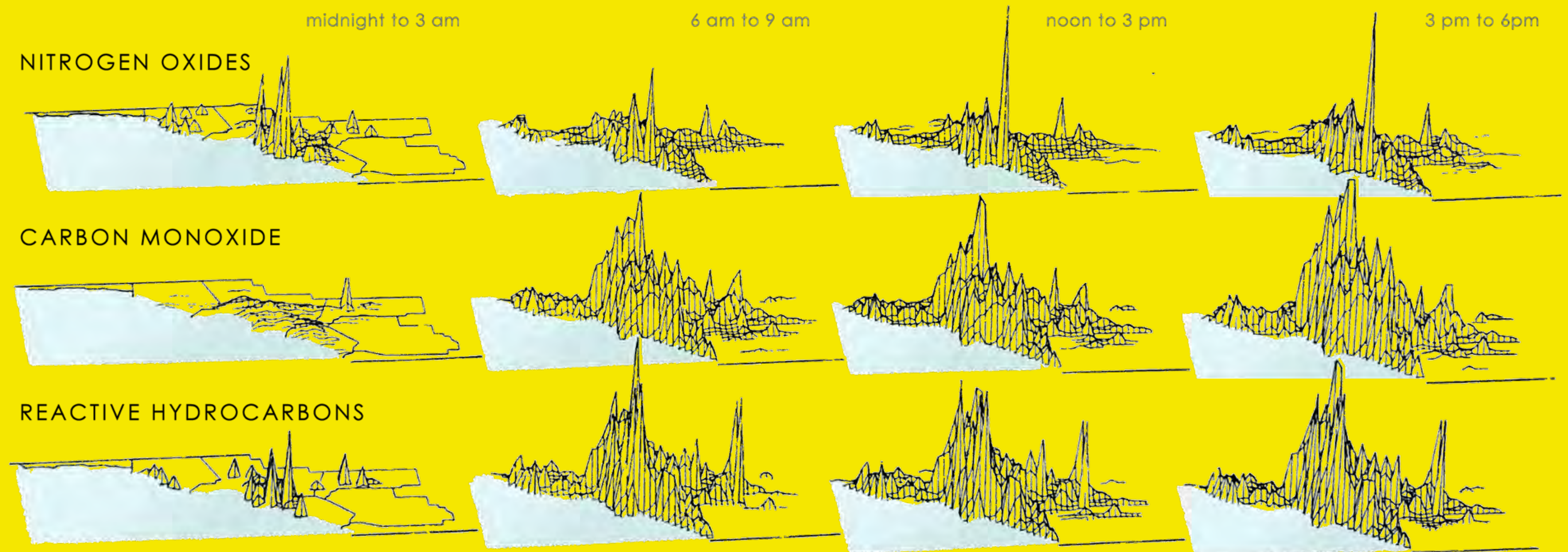
LAYERS











SMALL MULTIPLES

midnight to 3 am

6 am to 9 am

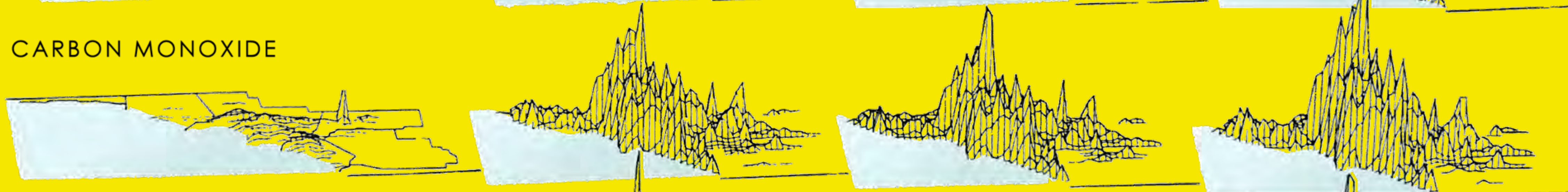
noon to 3 pm

3 pm to 6 pm

NITROGEN OXIDES



CARBON MONOXIDE



REACTIVE HYDROCARBONS

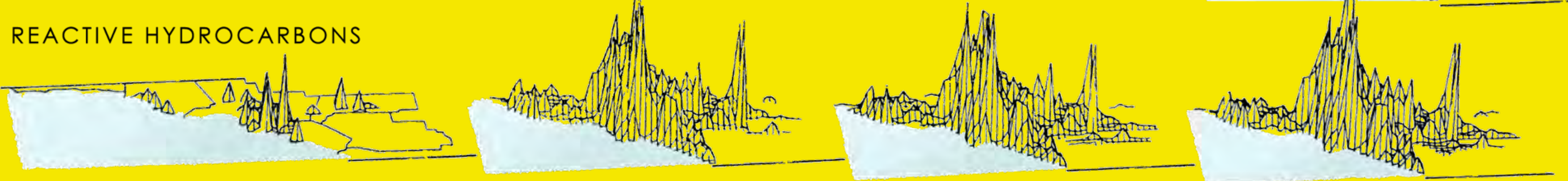
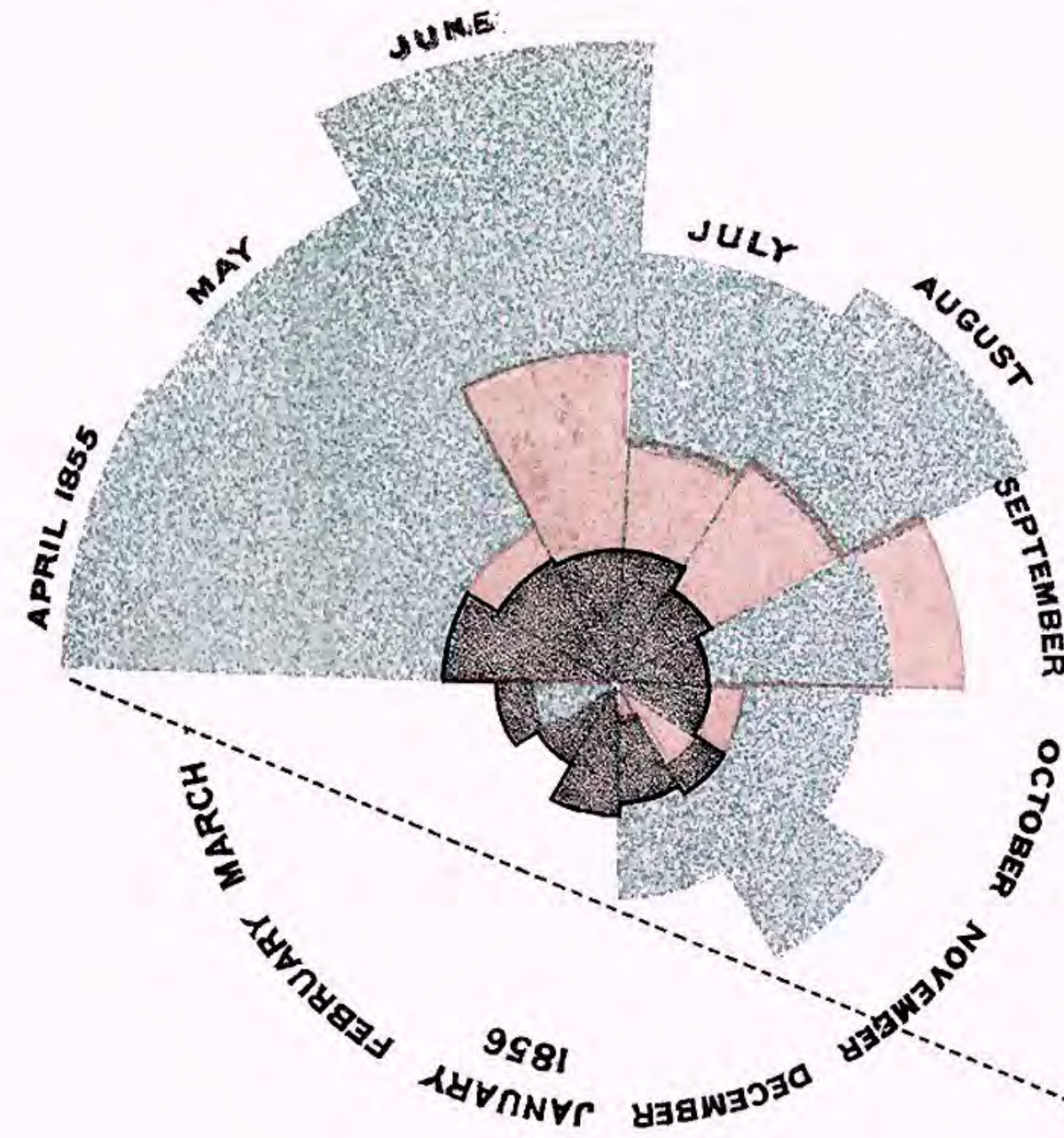
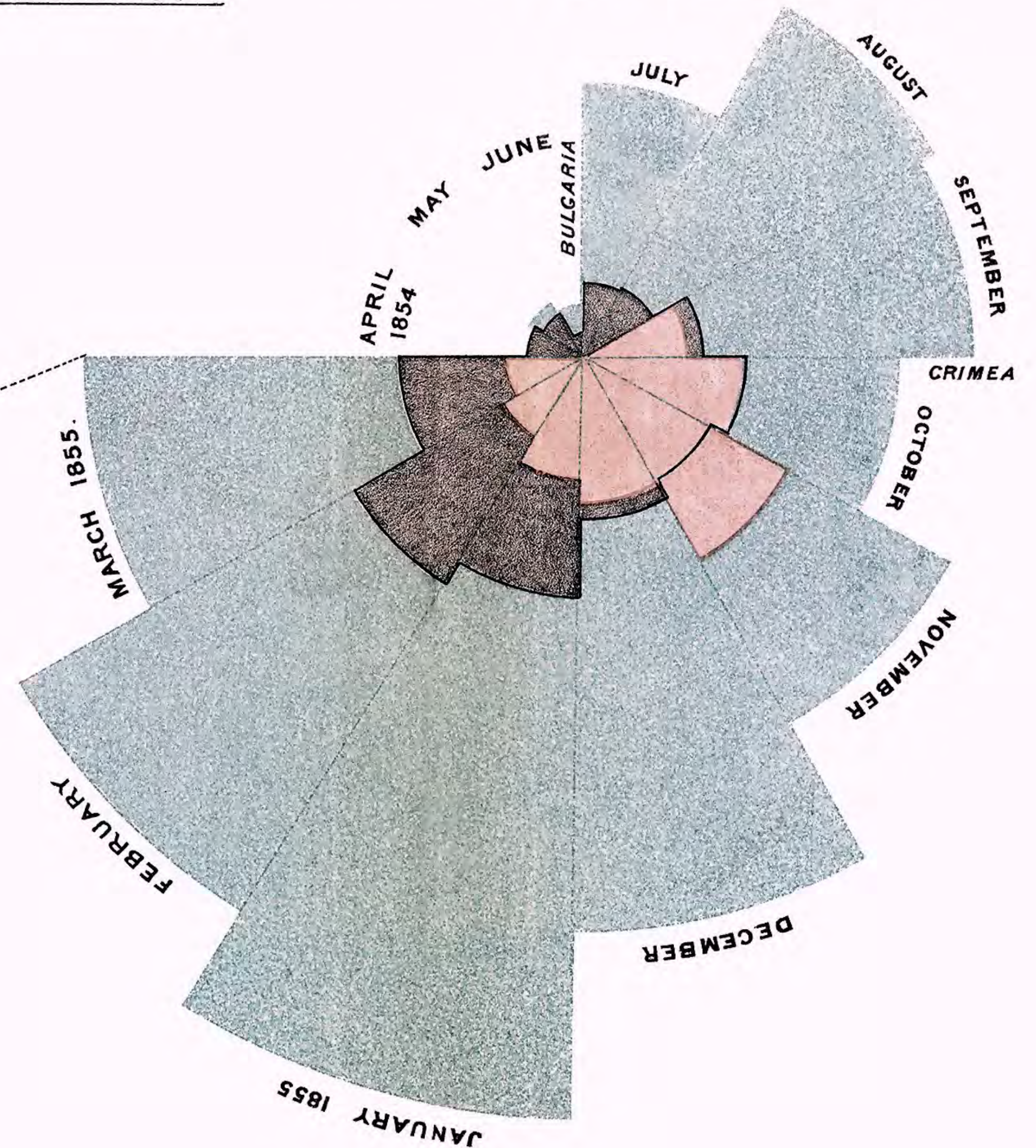


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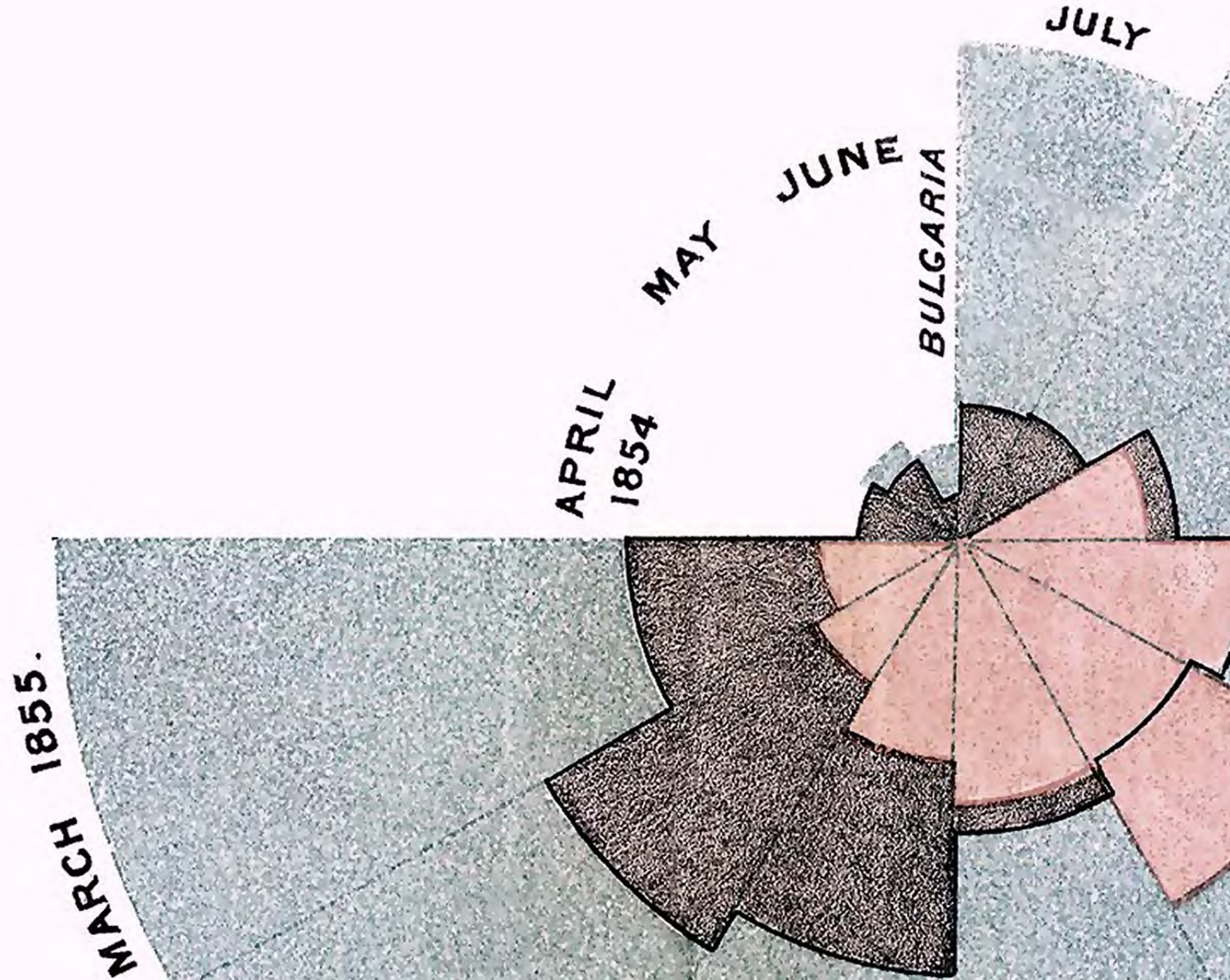
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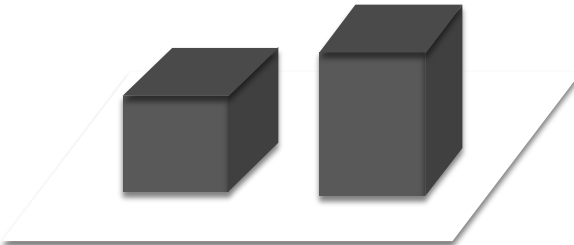
position + +

length ==

slope ↗

angle × ×

area ● ●

volume 

color ● ●



[

IN PERCEPTION]

BY NATURE OF DATA

[QUANTITATIVE]

1.1, 1.4, 1.7, 2.0, 2.3,

- POSITION
- LENGTH
- ANGLE
- SLOPE
- AREA
- VOLUME
- VALUE
- SATURATION
- HUE
- TEXTURE
- CONNECTION
- CONTAINMENT
- SHAPE

[ORDINAL]

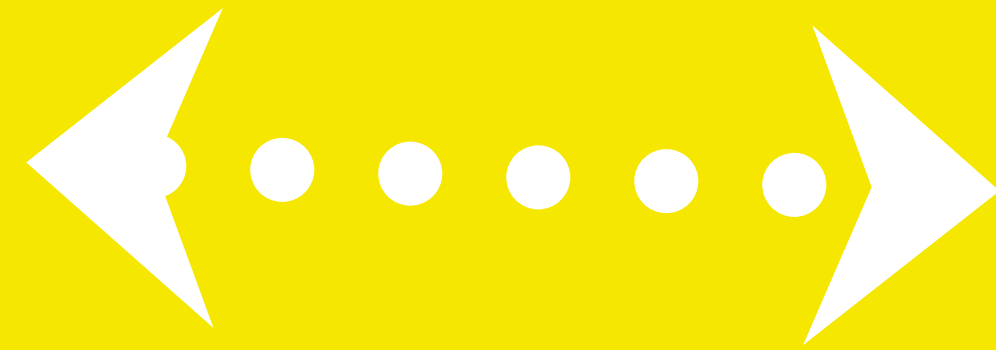
stage 1, stage 2, stage 3, ...

- POSITION
- VALUE
- SATURATION
- HUE
- TEXTURE
- CONNECTION
- CONTAINMENT
- LENGTH
- ANGLE
- SLOPE
- AREA
- VOLUME
- SHAPE

[NOMINAL]

messenger, ribosomal, transfer, ...

- POSITION
- HUE
- TEXTURE
- CONNECTION
- CONTAINMENT
- VALUE
- SATURATION
- SHAPE
- LENGTH
- ANGLE
- SLOPE
- AREA
- VOLUME

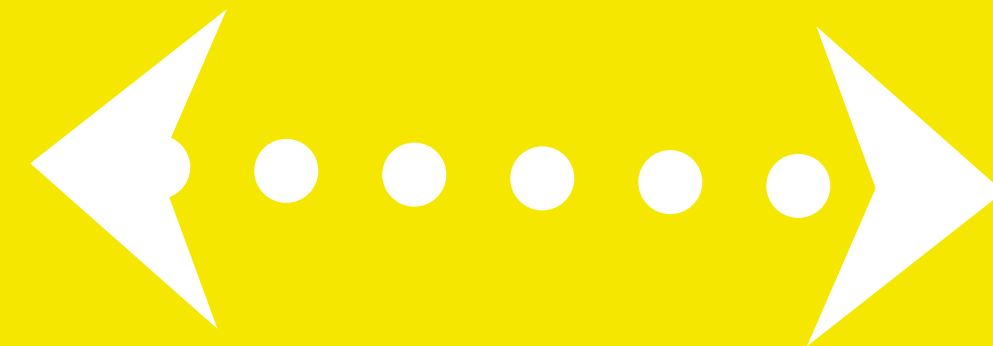


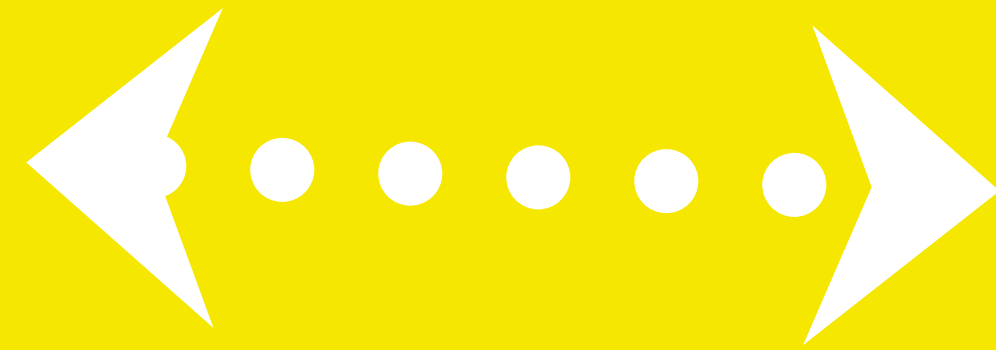


USER



REPRESENTATION





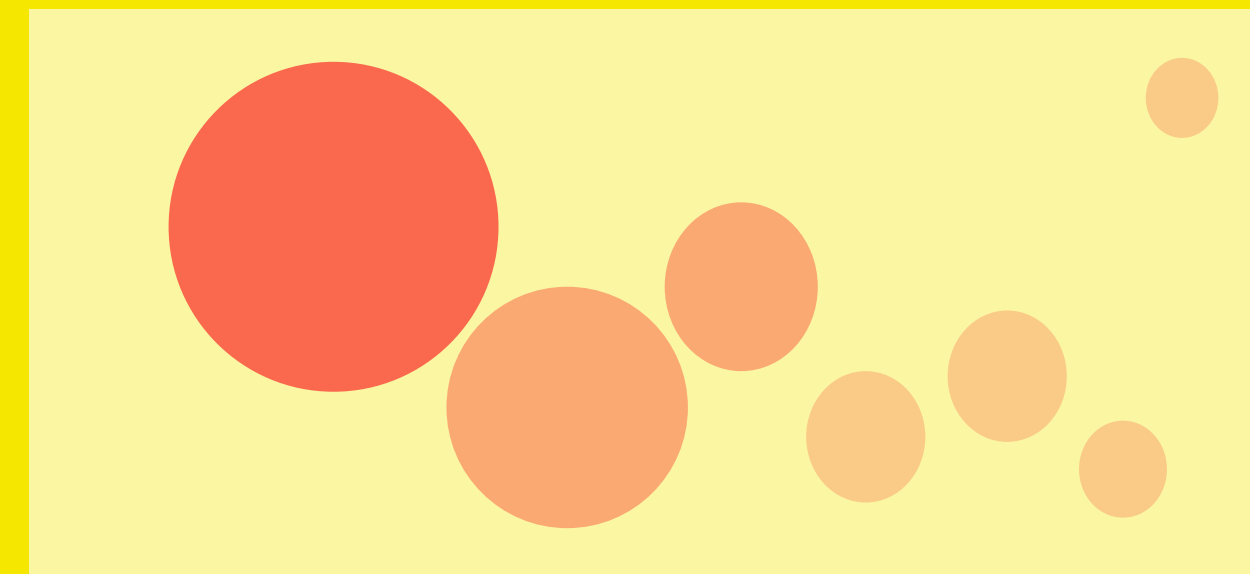
USER

QUESTION

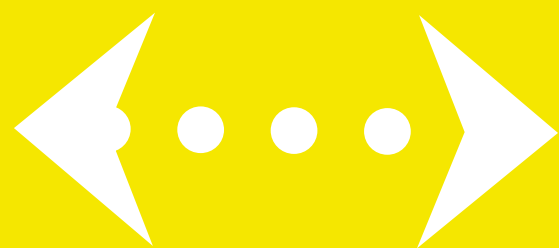
REPRESENTATION

TING
STUDENT

WHAT IS THE ____
TING CAN FIND AT ____
SUCH THAT ____ ?



PLOT EMPHASIZING
____ SORTED BY



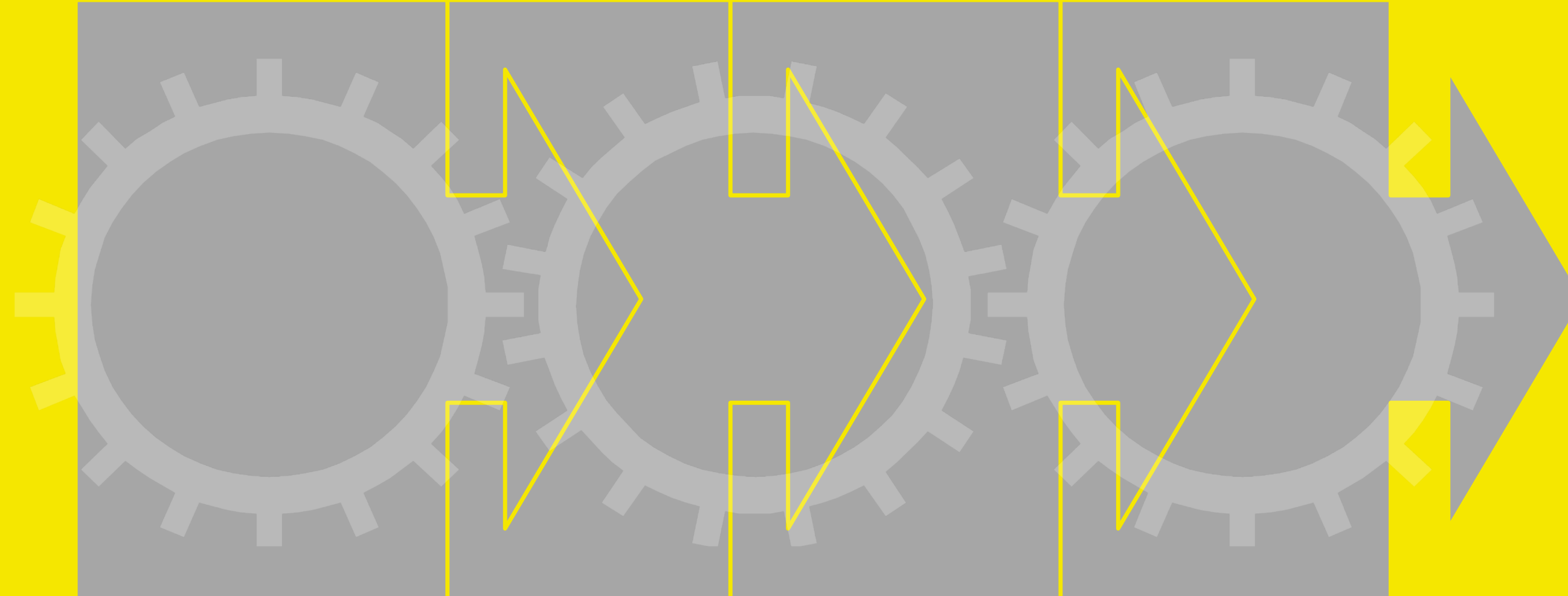
[VISUALIZATION PIPELINE]



WHAT IS DATA VISUALIZATION?

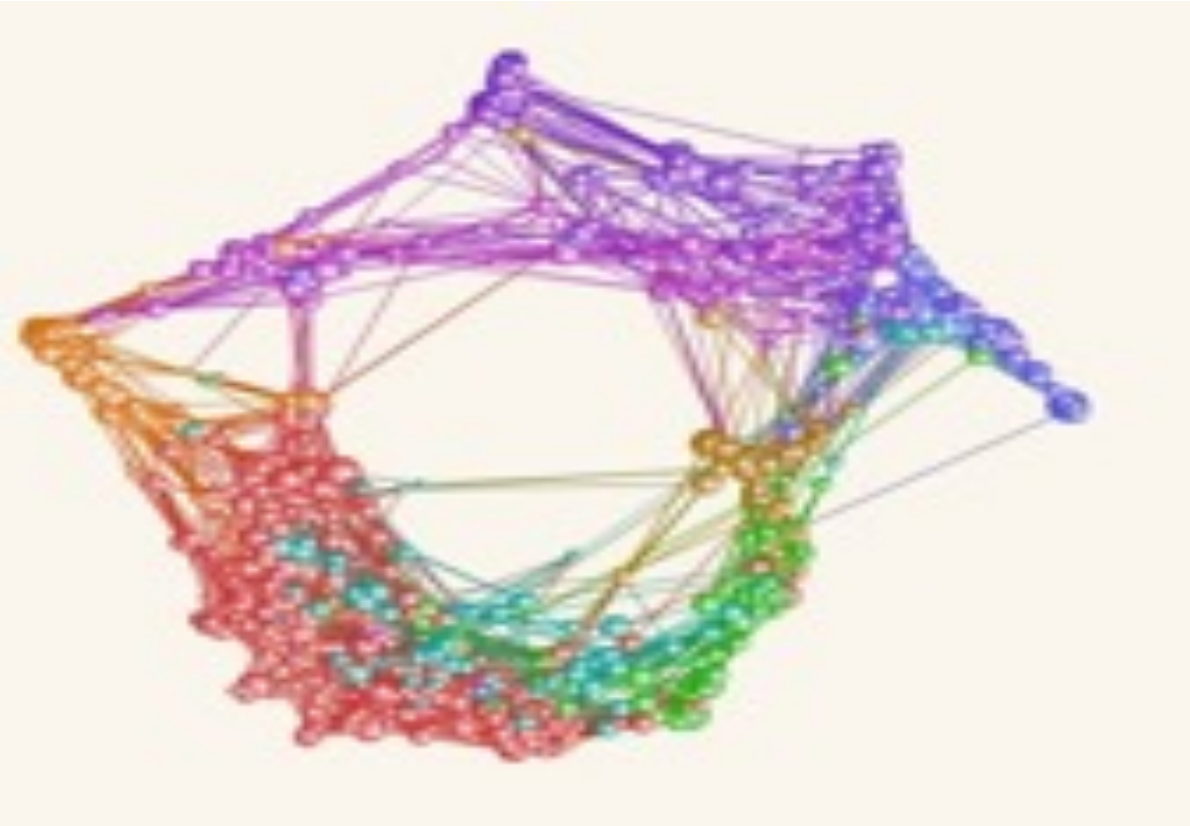
WISCONSIN
STATES
ENGINEERING

data + goal



⇒ viz engine ⇒

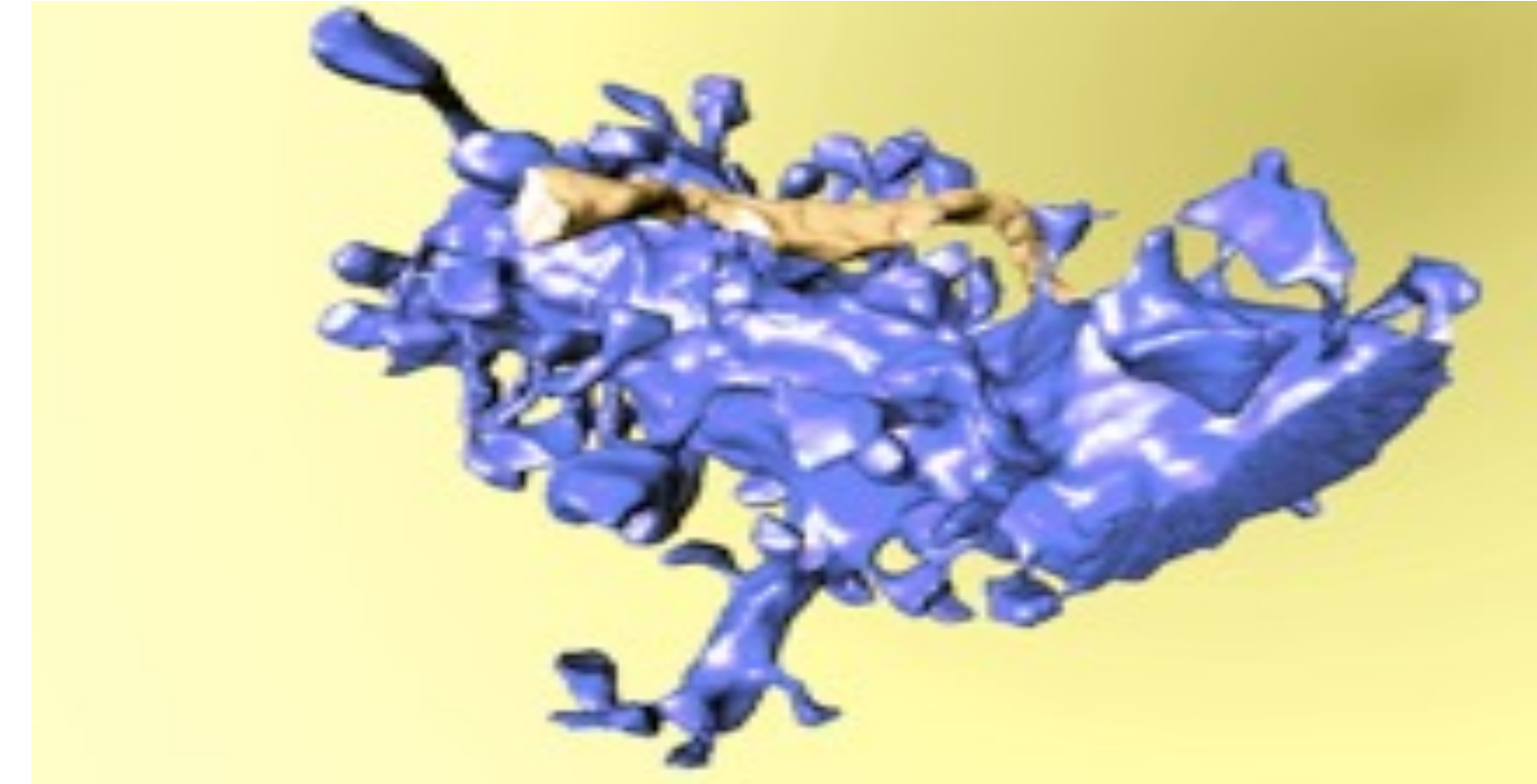
IMPORTANCE OF THE FIRST LOOK



ABSTRACT DATA

multi-dimensional data RECORDS

infoviz



2D/3D DATA

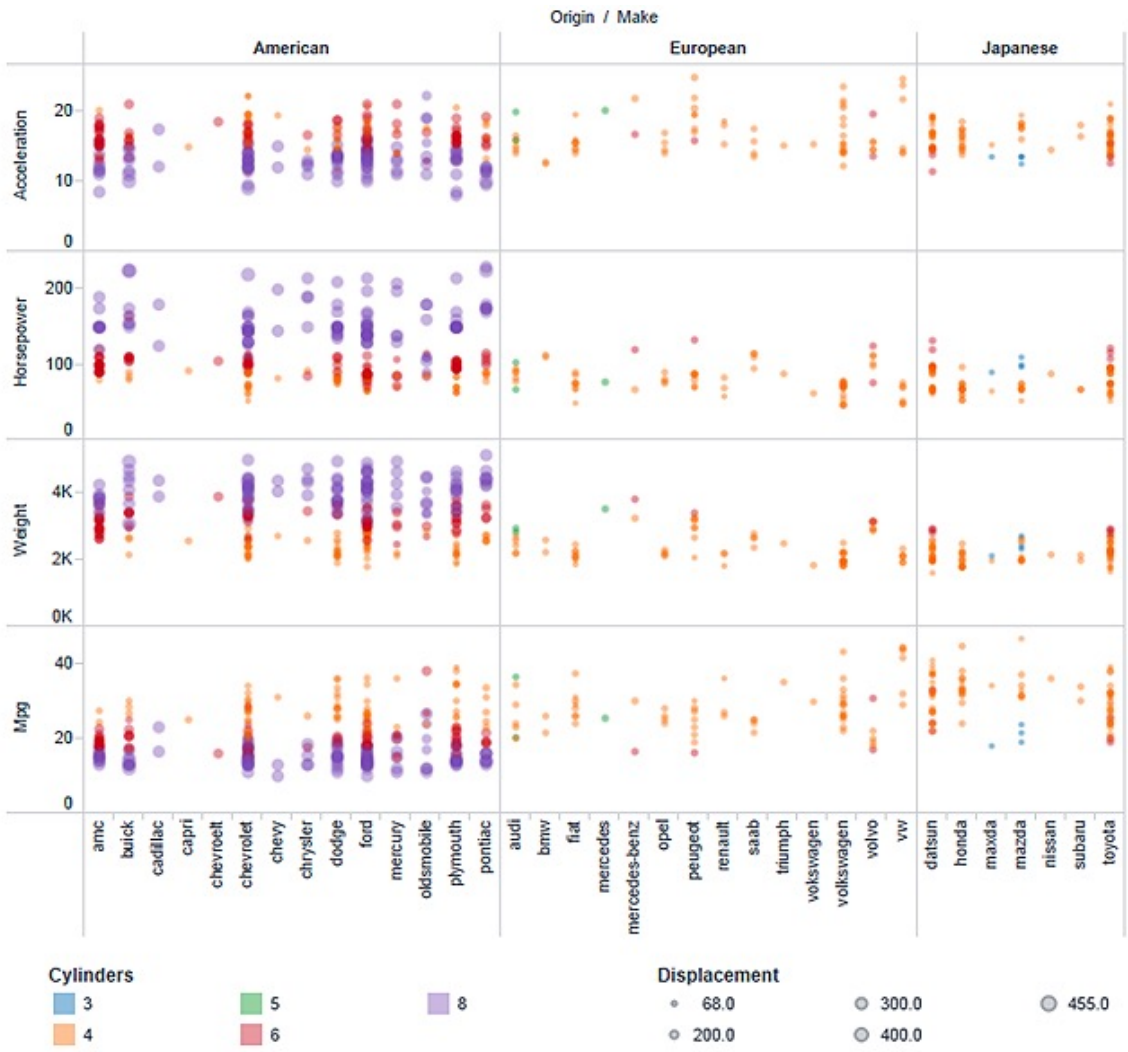
scalar/vector/tensor + time

sciviz

GEOMETRIC STRUCTURE

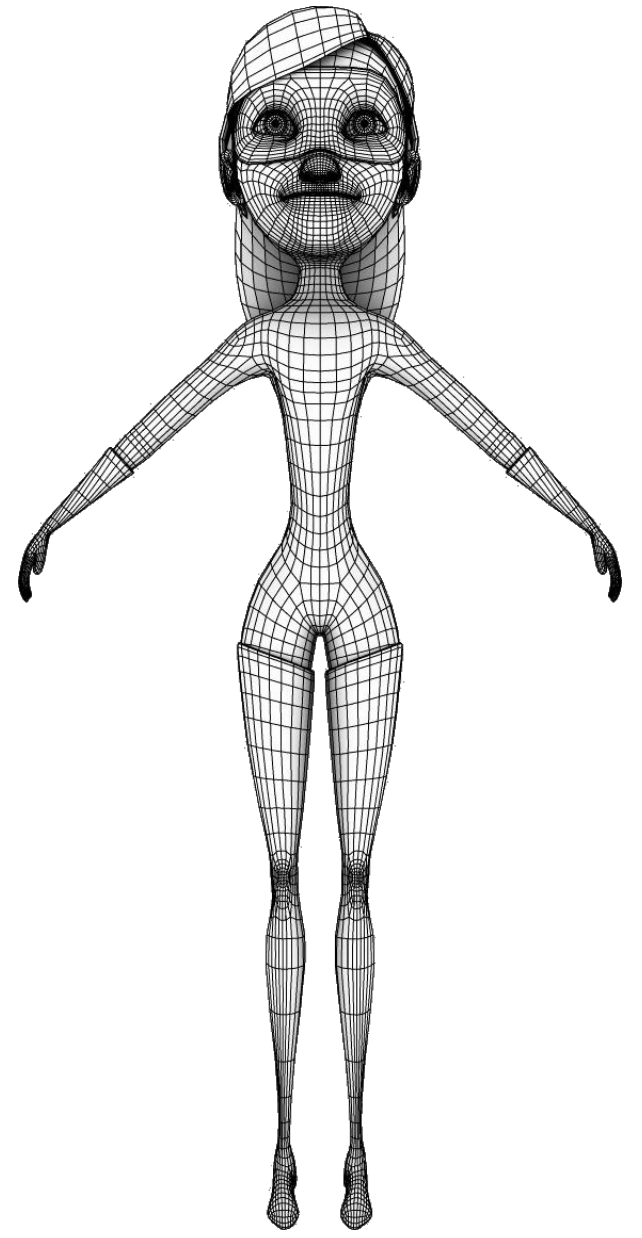
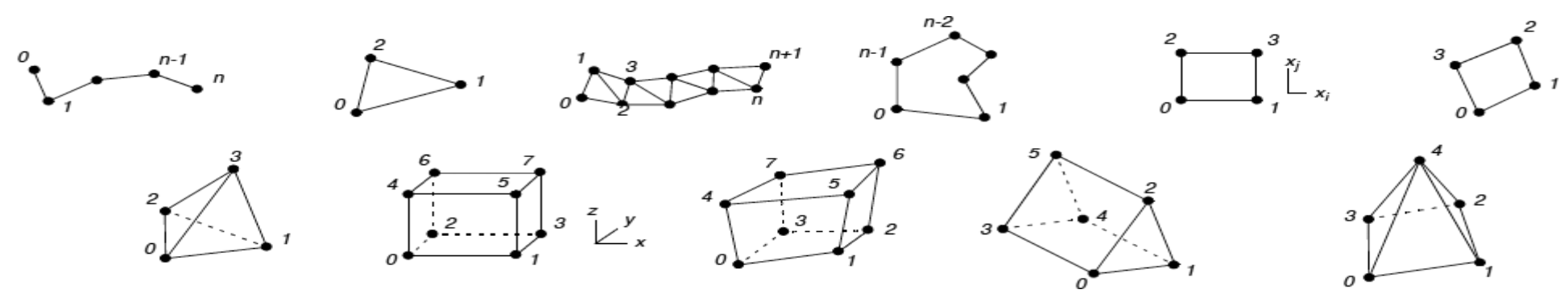
MPG Cylinders Horsepower Weight Acceleration Year Origin

8.	50.4	2.8	8.2	4	40.	250.	4	1500.	5500.	4	5.	30.	4	69.5	82.5	4	.8	3.2	3
18.000000	8.000000	130.000000	3504.000000	12.000000	70.000000	1.000000													
15.000000	8.000000	165.000000	3693.000000	11.500000	70.000000	1.000000													
18.000000	8.000000	150.000000	3436.000000	11.000000	70.000000	1.000000													
16.000000	8.000000	150.000000	3433.000000	12.000000	70.000000	1.000000													
17.000000	8.000000	140.000000	3449.000000	10.500000	70.000000	1.000000													
...	...	...	...	...	...	...													



ABSTRACT DATA

GEOMETRIC STRUCTURE



2D/3D DATA

RESOURCES

IEEE VIS CONFERENCE

SciVis | InfoVis | VAST

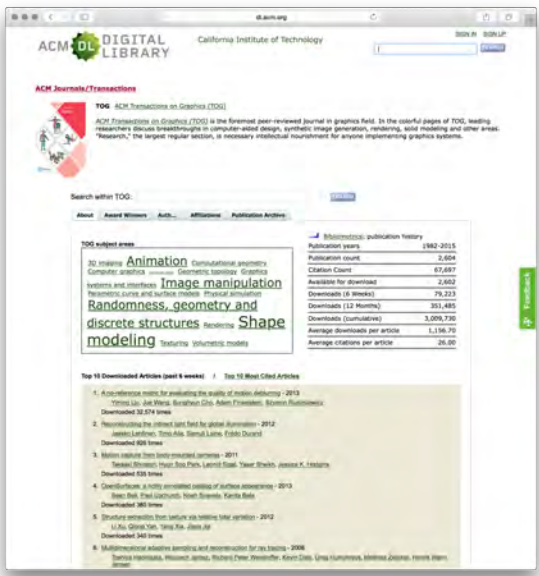
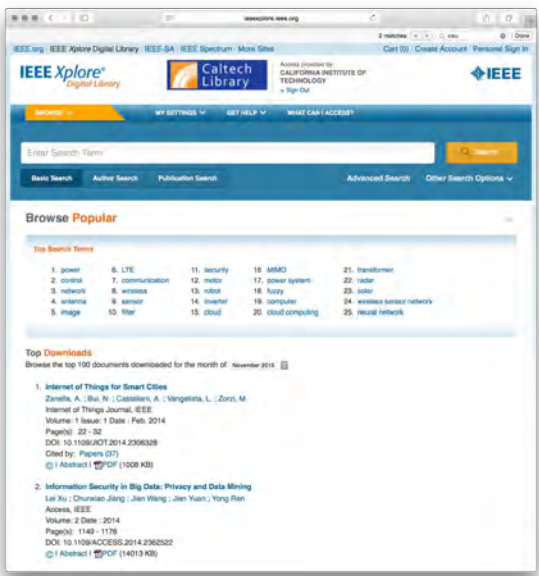
 IEEE Xplore

<https://clsproxy.library.caltech.edu/login?url=http://ieeexplore.ieee.org/Xplore/DynWel.jsp>

ACM Siggraph Conference

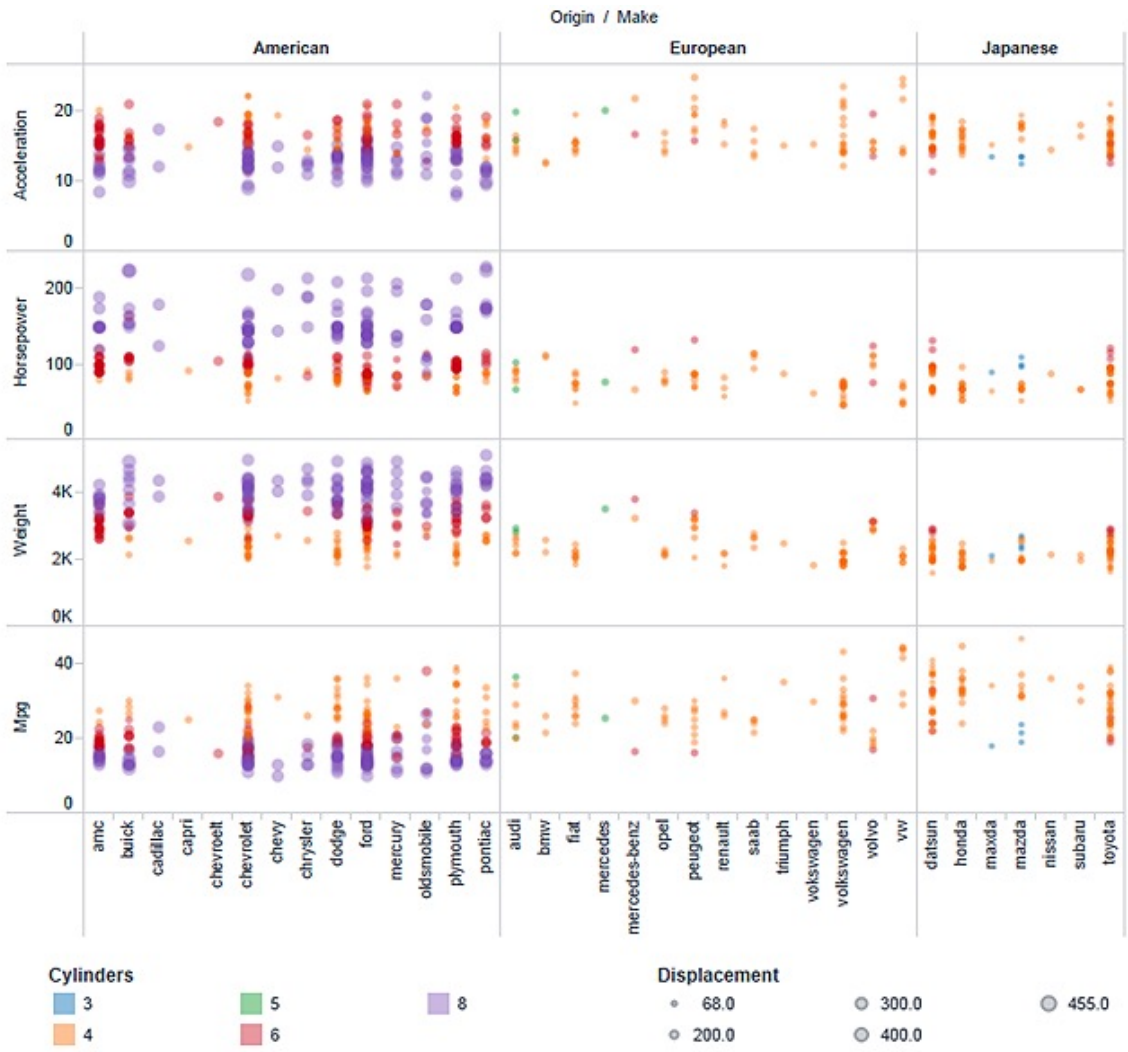
 ACM Digital Library

<https://clsproxy.library.caltech.edu/login?url=http://portal.acm.org/dl.cfm>

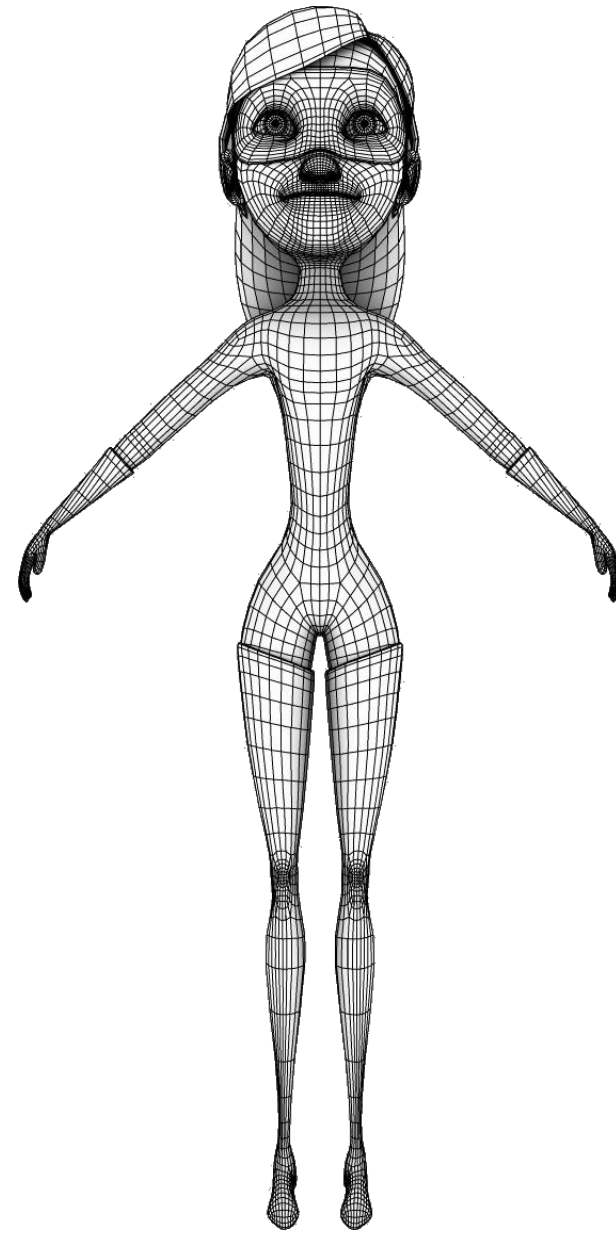
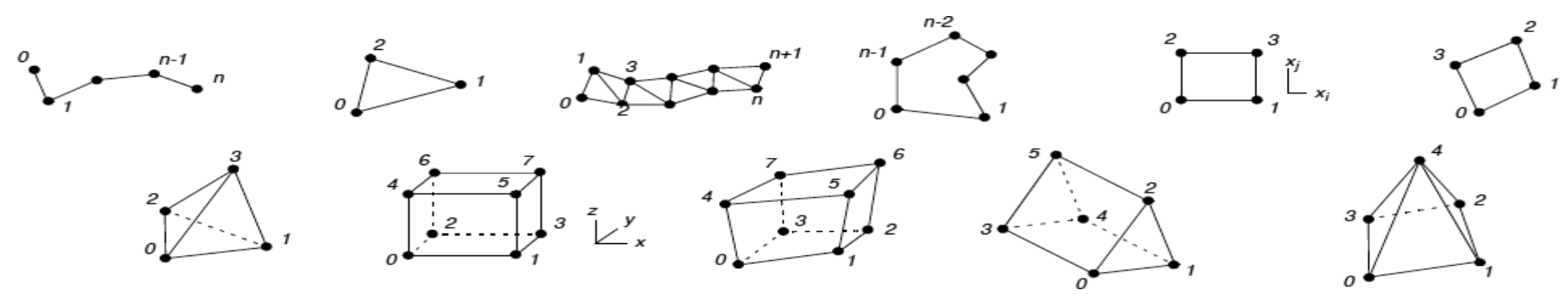


MPG Cylinders Horsepower Weight Acceleration Year Origin

8.50	4.2	8.2	4.4	40.2	50.4	1500.5	500.4	5.3	0.4	69.5	82.5	4.8	3.2	3	18.000000	8.000000	130.000000	3504.000000	12.000000	70.000000	1.000000
15.000000	8.000000	165.000000	3693.000000	11.500000	70.000000	1.000000	18.000000	8.000000	150.000000	3436.000000	11.000000	70.000000	1.000000	16.000000	8.000000	150.000000	3433.000000	12.000000	70.000000	1.000000	
17.000000	8.000000	140.000000	3449.000000	10.500000	70.000000	1.000000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	

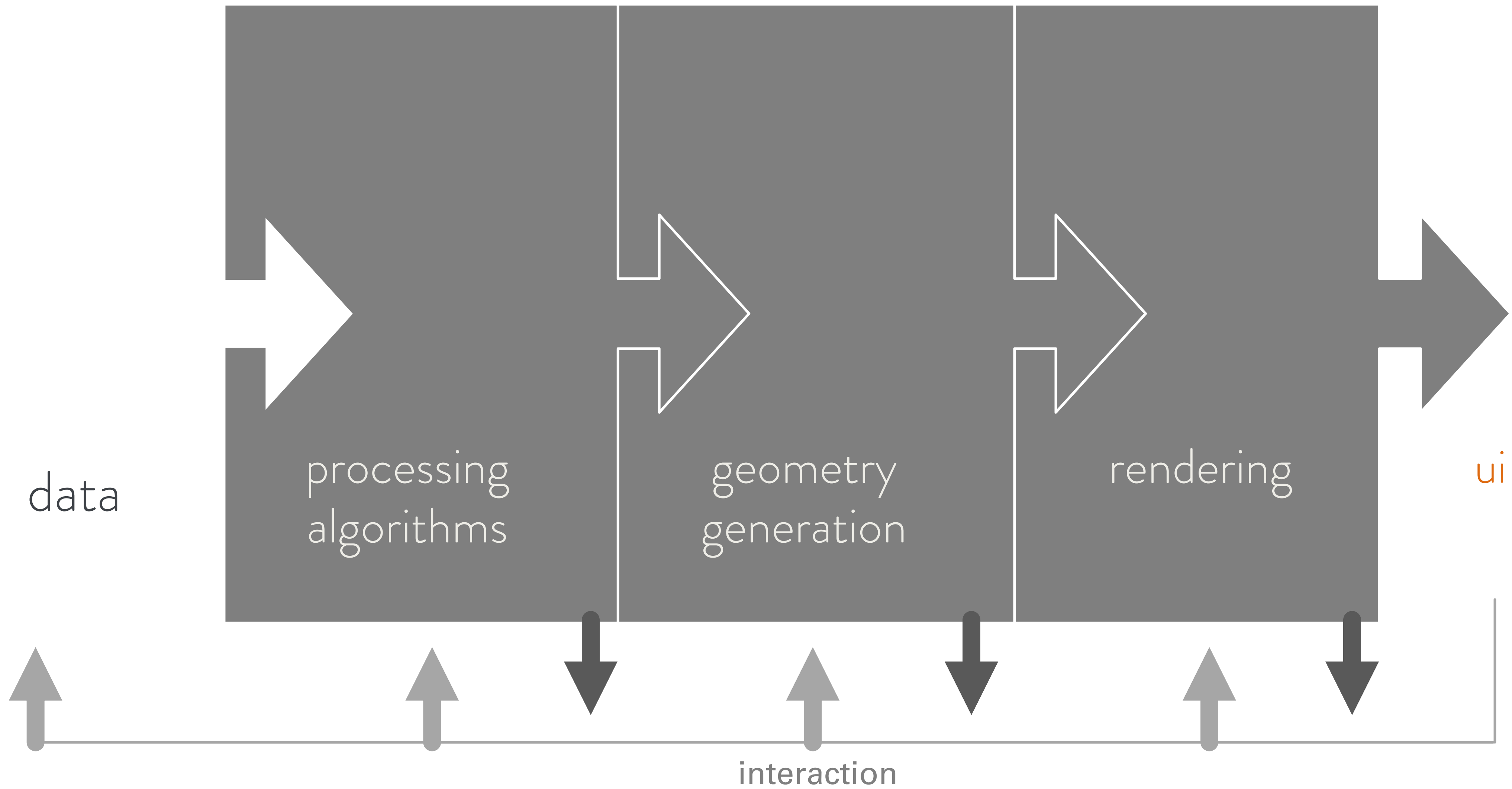


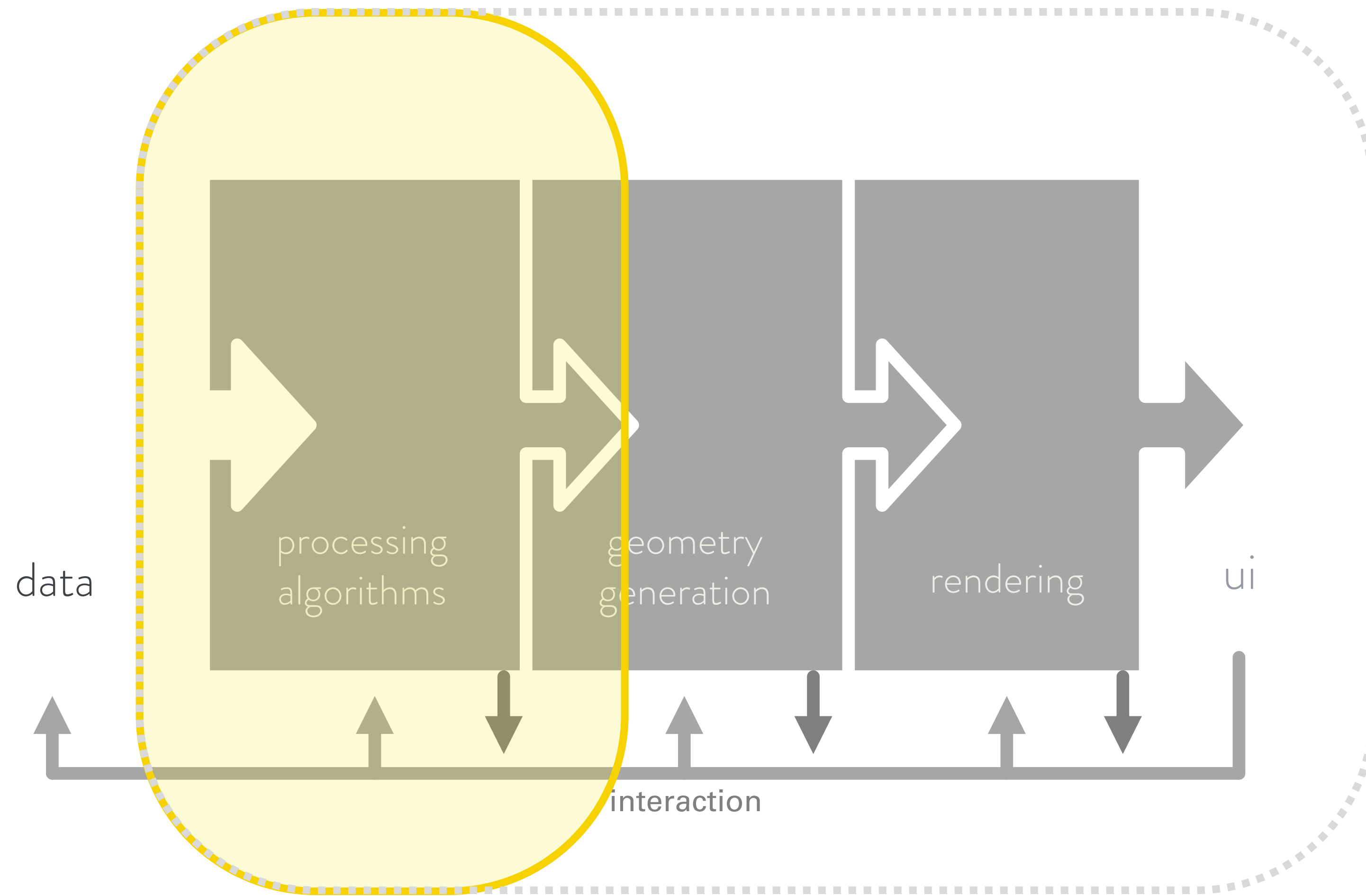
ABSTRACT DATA



2D/3D DATA

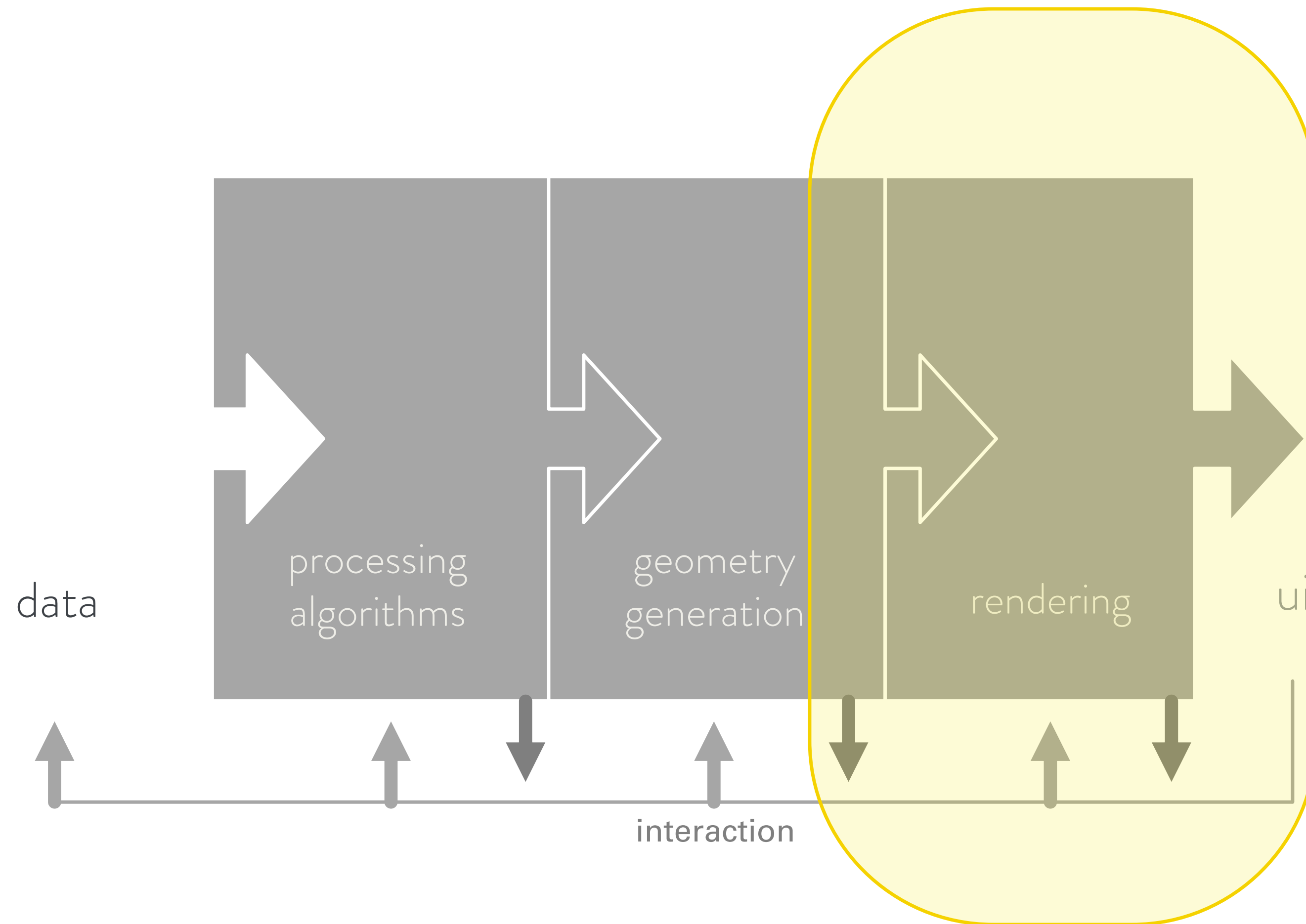
GEOMETRIC STRUCTURE





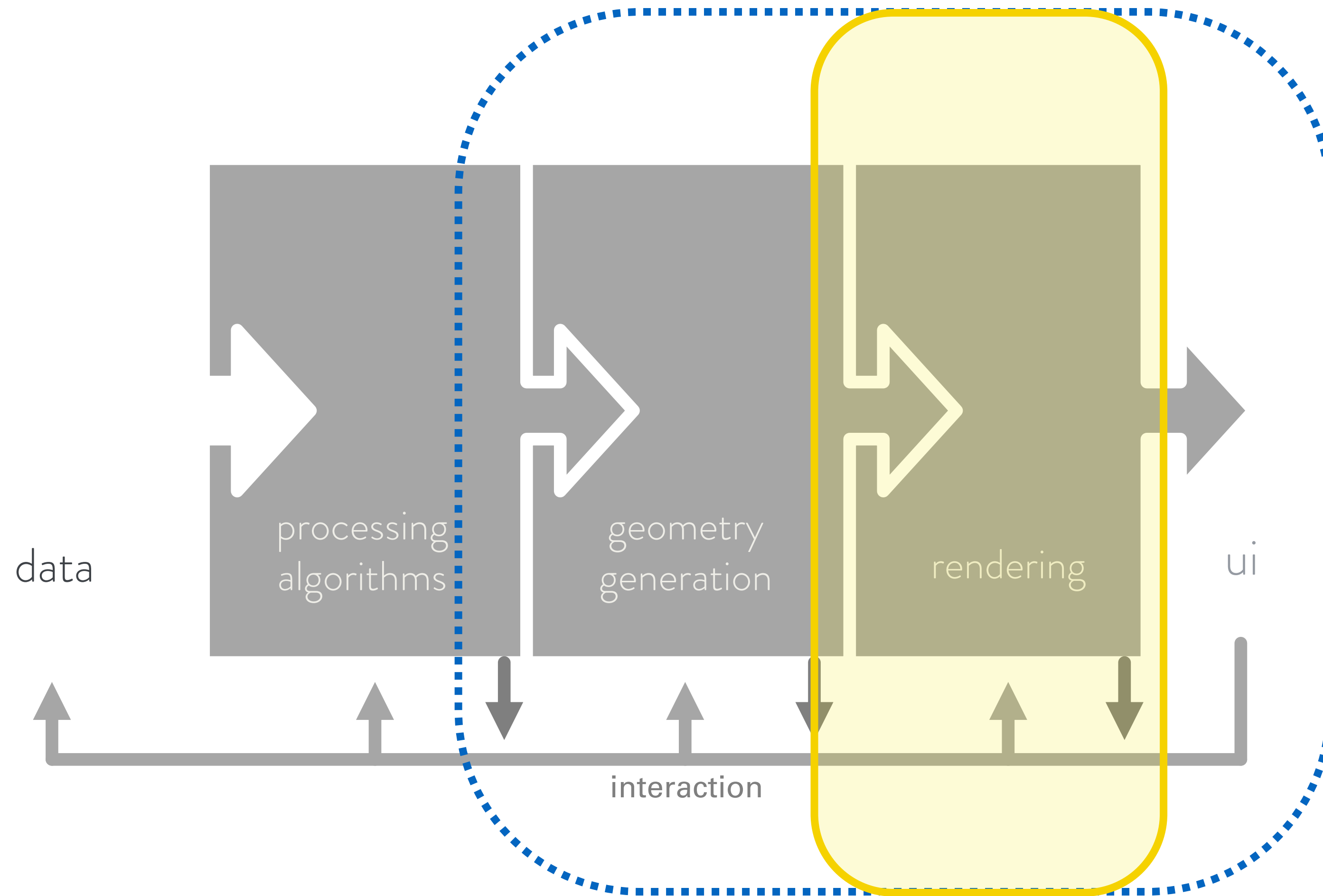
- VTK
- python/qt
- c/c++
- tcl/tk
- java
- R

INTERACTIVE RENDERERS



- OpenGL
 - MESAGL
 - DIRECT3D
 - OPENGL ES
- WebGL → WebGPU
 - three.js
 - babylon.js
- HIGHER LEVEL:
 - OpenInventor
 - C++/GL
 - COIN
 - UNITY/UNREAL

RAY TRACERS

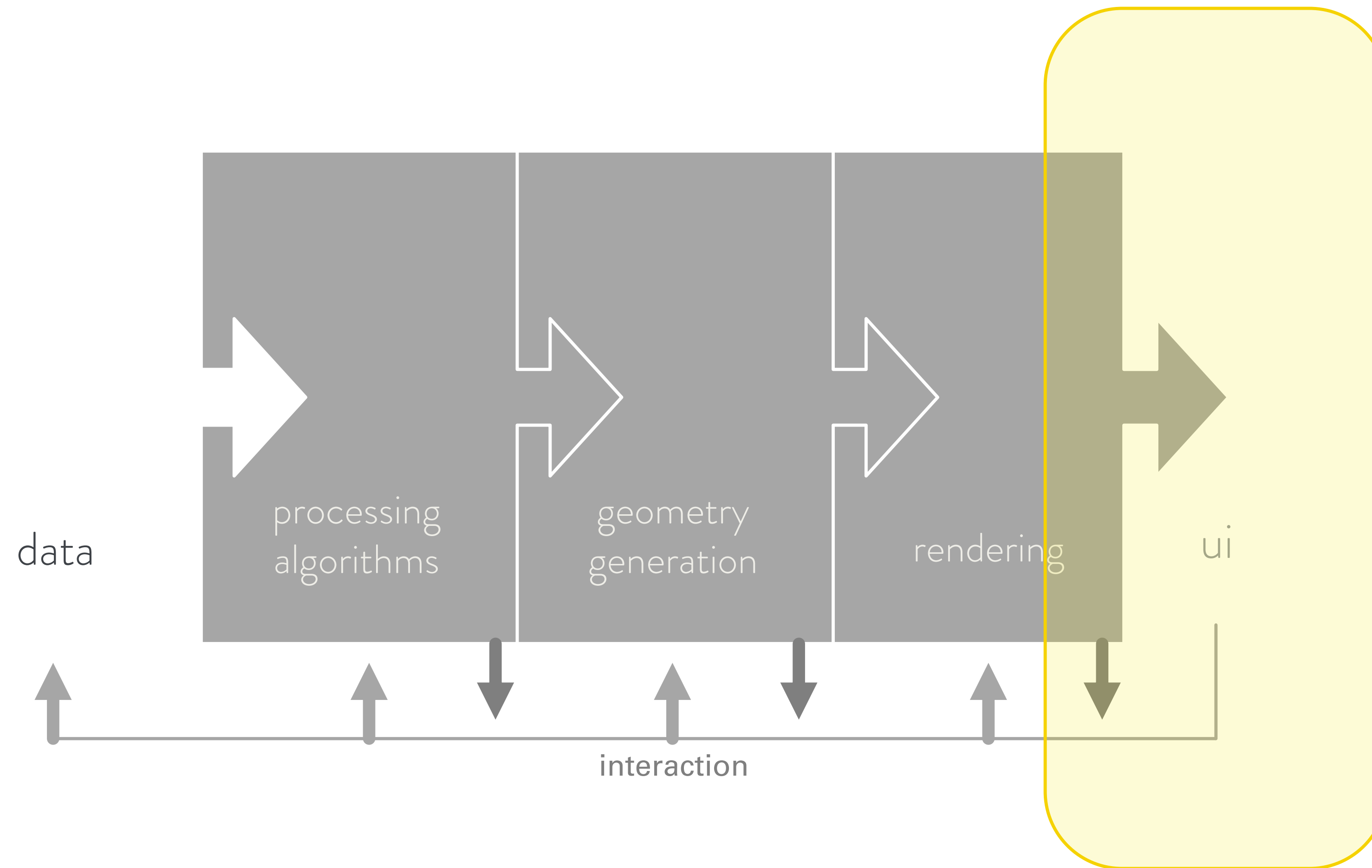


- POV-Ray
- RenderMan^{\$\$}

MODELLERS:

- Blender
- Maya^{\$\$}

GUI TOOLKITS



- Javascript
 - Vue, React

- QT/Python

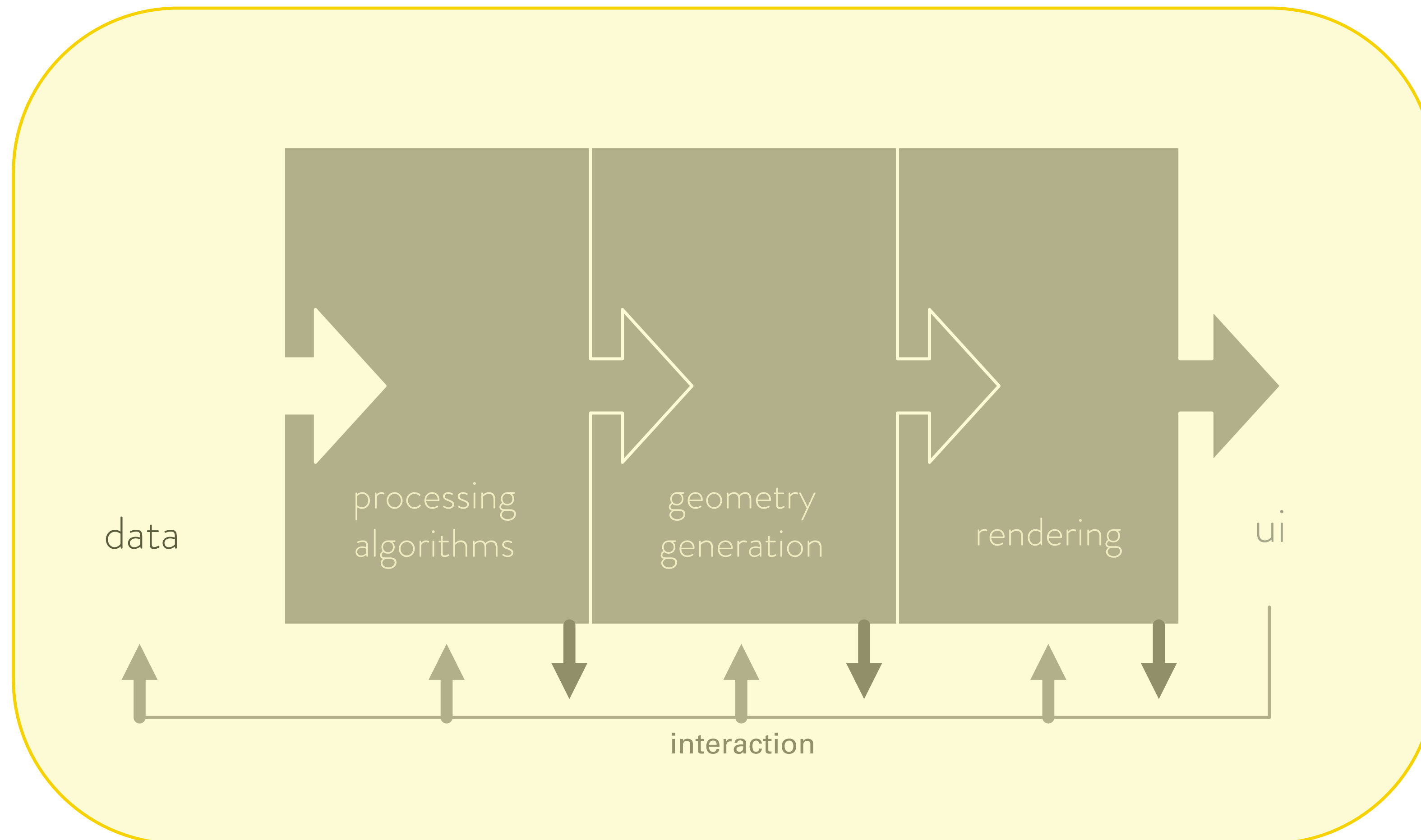
LEGACY

- GTK+/Python
- TK (TCL/TK)

HARDWARE SPECIFIC

- iOS, Android
- Java Swing
- Cocoa, Motiff...

VISUALIZATION SYSTEMS



- Paraview^{VTK}
- LLNL VisIt^{VTK}
- EnSight^{\$}
- Matlab^{\$}
- tableau^{\$}
- [CODE D3js^{WWW}](#)
- Observable^{WWW}
- Flourish^R
- TomCat, Mollegro, ...



Connect

Search for Data

Tableau Server

To a File

Microsoft Excel

Text file

JSON file

PDF file

Spatial file

Statistical file

More...

To a Server

Microsoft SQL Server

MySQL

Oracle

Amazon Redshift

More...



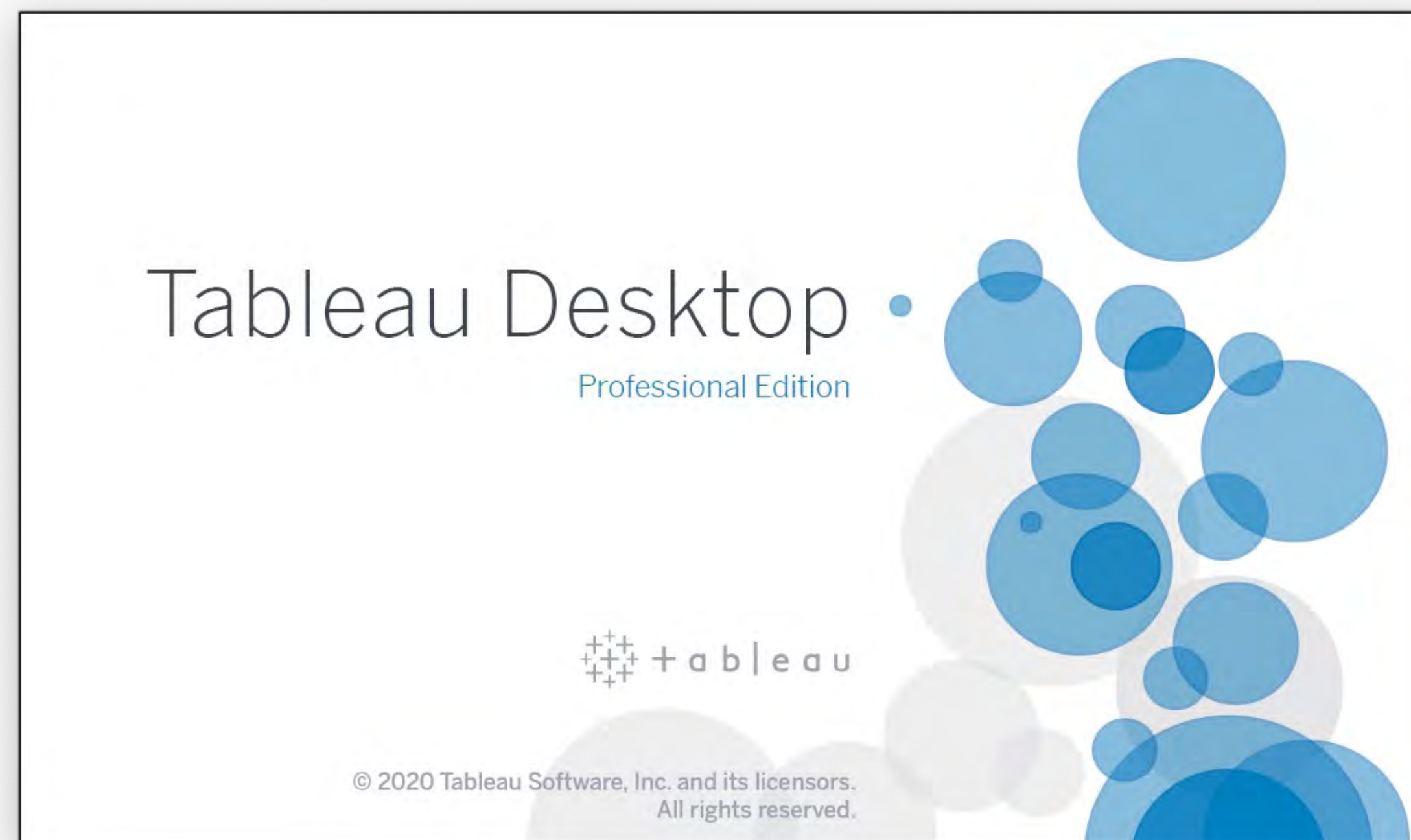
Saved Data Sources

Sample - Superstore

World Indicators

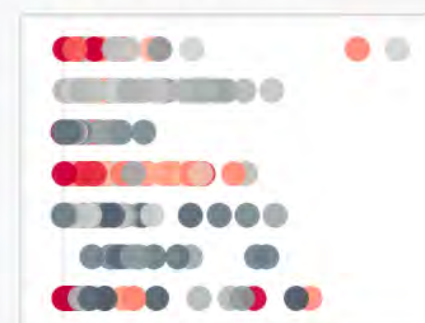
Open

[Open a Workbook](#)

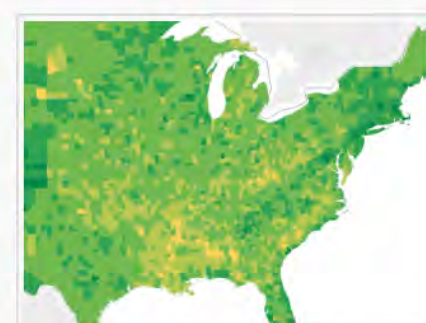


[More Samples](#)

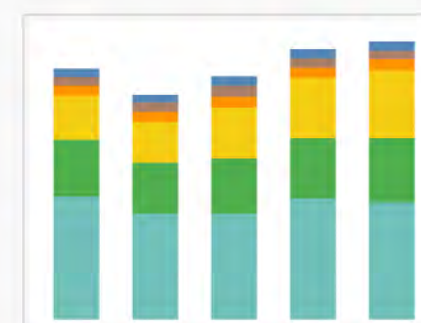
Sample Workbooks



Superstore

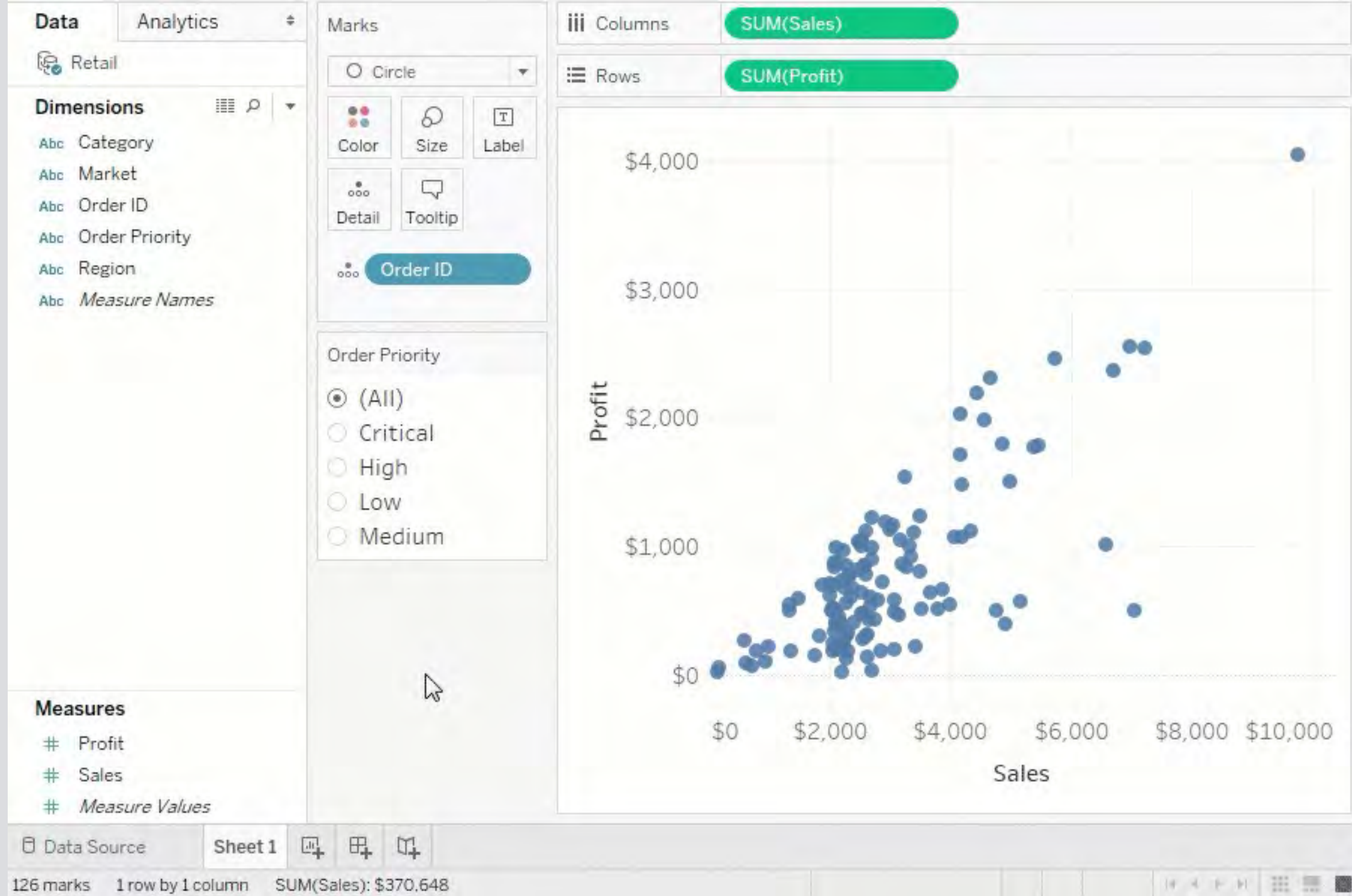


Regional



World Indicators

TABLEAU



TABLEAU



p5.js

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Using the metaphor of a sketch, p5.js has a full set of drawing functionality. However, you're not limited to your drawing canvas. You can think of your whole browser page as your sketch, including HTML5 objects for text, input, video, webcam, and sound.

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Start creating with the p5 Editor!

Community

p5*

File Edit Sketch Help

English Hello, santiago.lombeyda!

▶

■

☐ Auto-refresh

Quick Titanic View *✎* by santiago.lombeyda

sketch.js Saved: about 21 hours ago Preview

```
1 let db=null;
2 function setup() {
3   createCanvas(400, 400);
4   db=loadTable('titanic.csv', 'csv', 'header');
5   frameRate(10);
6   textSize(8);
7 }
8
9 function draw() {
10  background(20,40,100);
11  noStroke();
12  fill(255,255,255,180);
13  text("FIRST CLASS". 75.375):
```

Console Clear

SEP IS ,

● FEMALE

● MALE

A cluster of yellow and purple dots representing survivors in first class.

A cluster of yellow and purple dots representing survivors in second class.

A cluster of yellow and purple dots representing survivors in third class.

SURVIVED

A cluster of mostly purple dots representing those who died in first class.

A cluster of mostly purple dots representing those who died in second class.

A cluster of mostly purple dots representing those who died in third class.

DIED

FIRST CLASS

SECOND CLASS

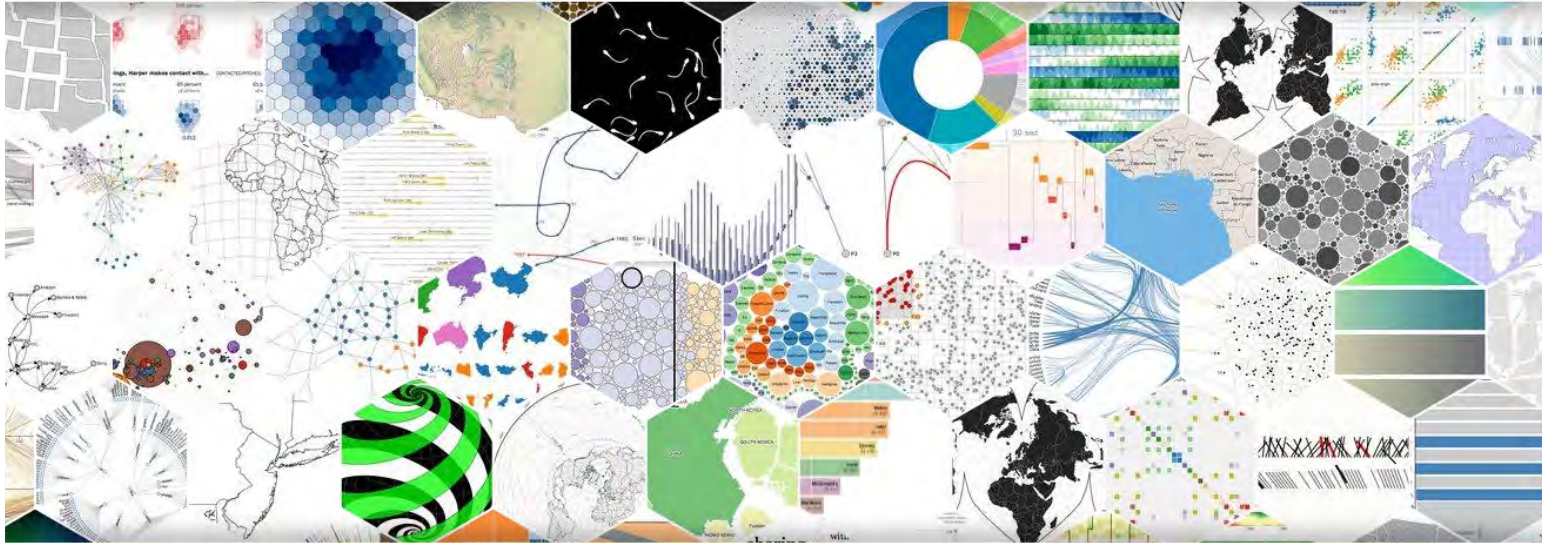
THIRD CLASS



[Overview](#) [Examples](#) [Documentation](#) [API](#) [Source](#)



Data-Driven Documents



Like visualization and creative coding? Try interactive JavaScript notebooks in **Observable!**

D3.js is a JavaScript library for manipulating documents based on data. **D3** helps you bring data to life using HTML, SVG, and CSS. D3's emphasis on web standards gives you the full capabilities of modern browsers without tying yourself to a proprietary framework, combining powerful visualization components and a data-driven approach to DOM manipulation.

Download the latest version (7.7.0) here:

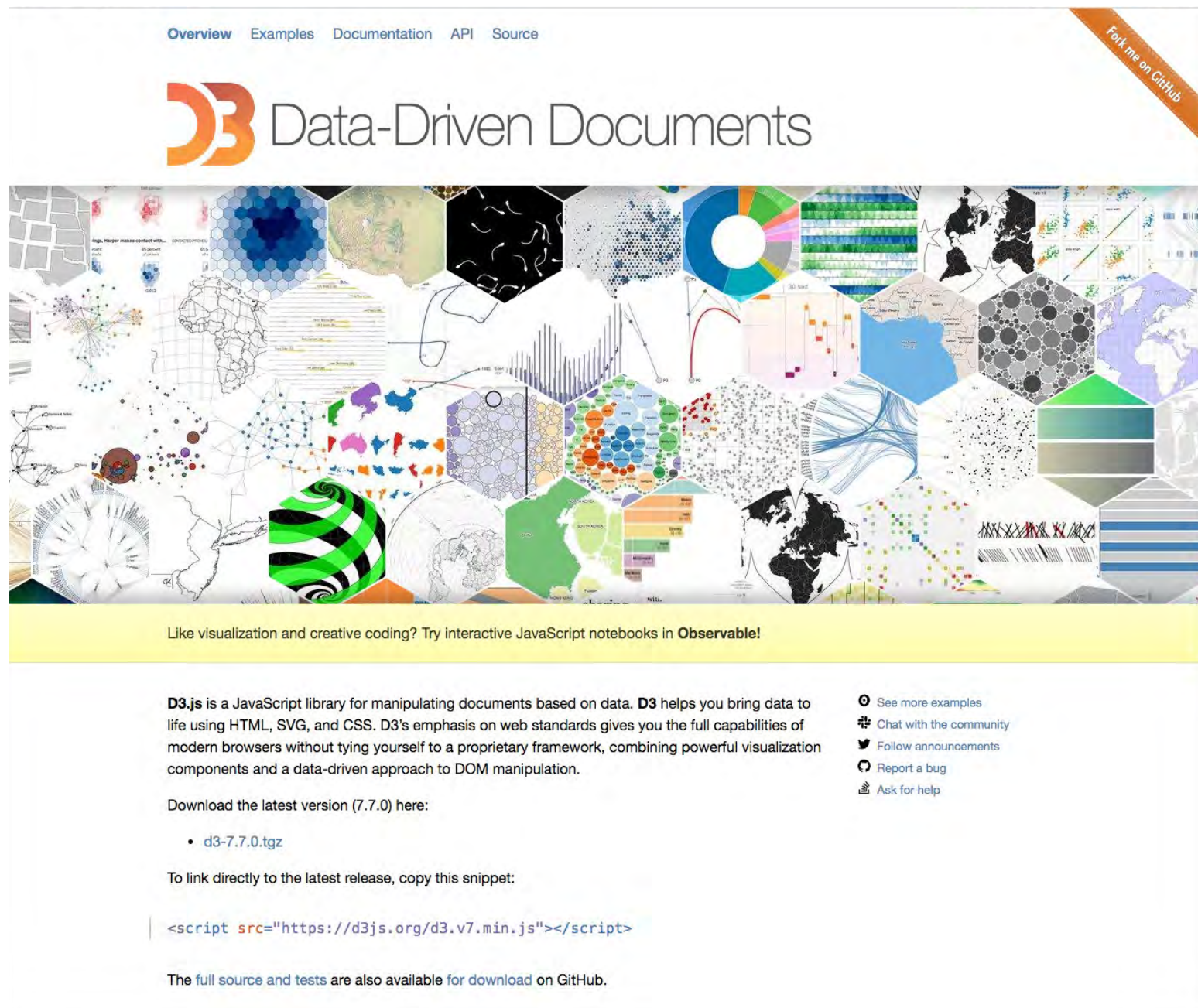
- [d3-7.7.0.tgz](#)

To link directly to the latest release, copy this snippet:

```
<script src="https://d3js.org/d3.v7.min.js"></script>
```

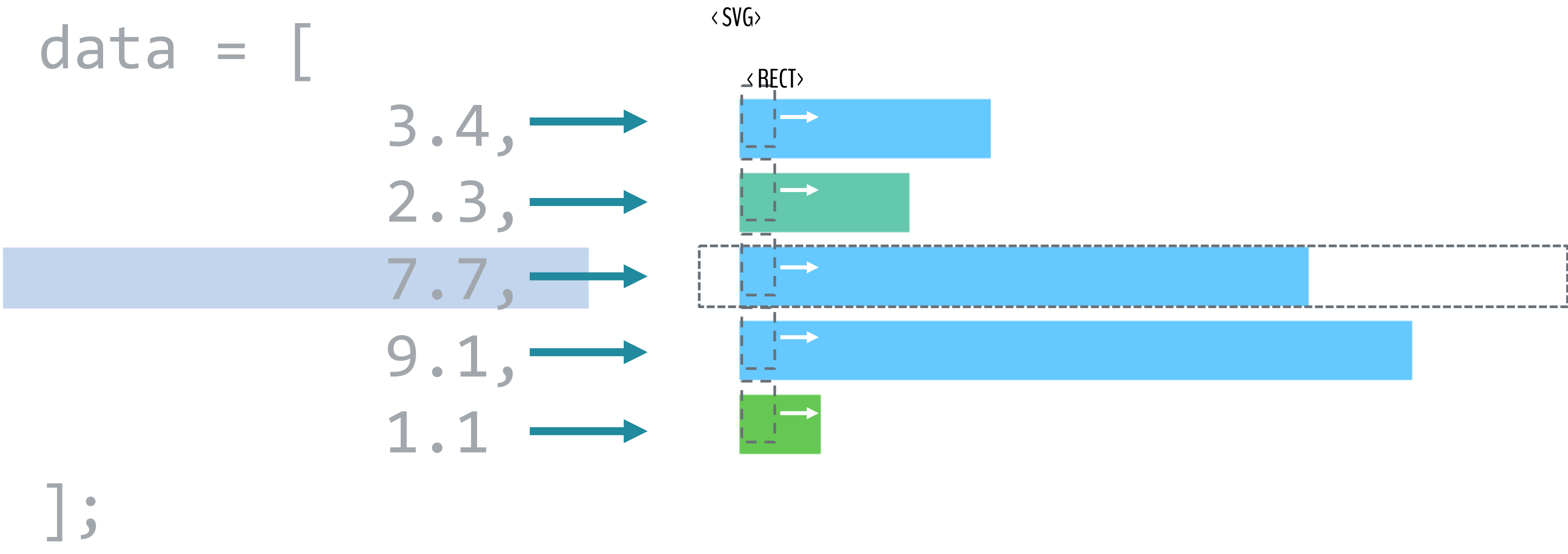
The [full source](#) and [tests](#) are also available for download on [GitHub](#).

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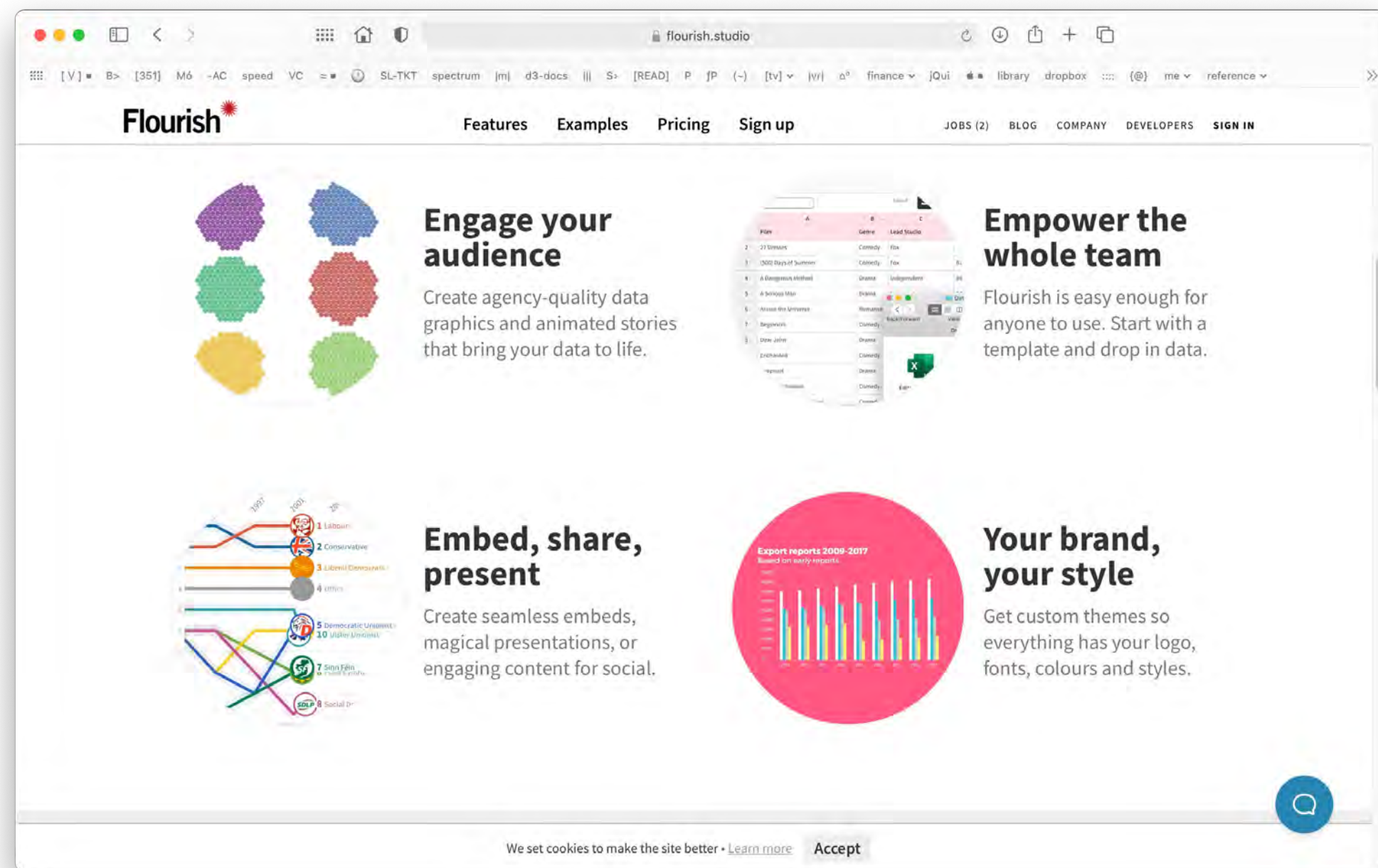
```
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var rects = d3.select('svg')
    .selectAll('rect')
    .data(data)
    .enter()
    .append('rect')
    .attr('width', (d,i) => d*100)
    .attr('height', 40)
    .attr('x', 40)
    .attr('y', (d,i) => i*50+50)
    .attr('fill', (d,i) => d3.rgb(100,200,d*75) );
```



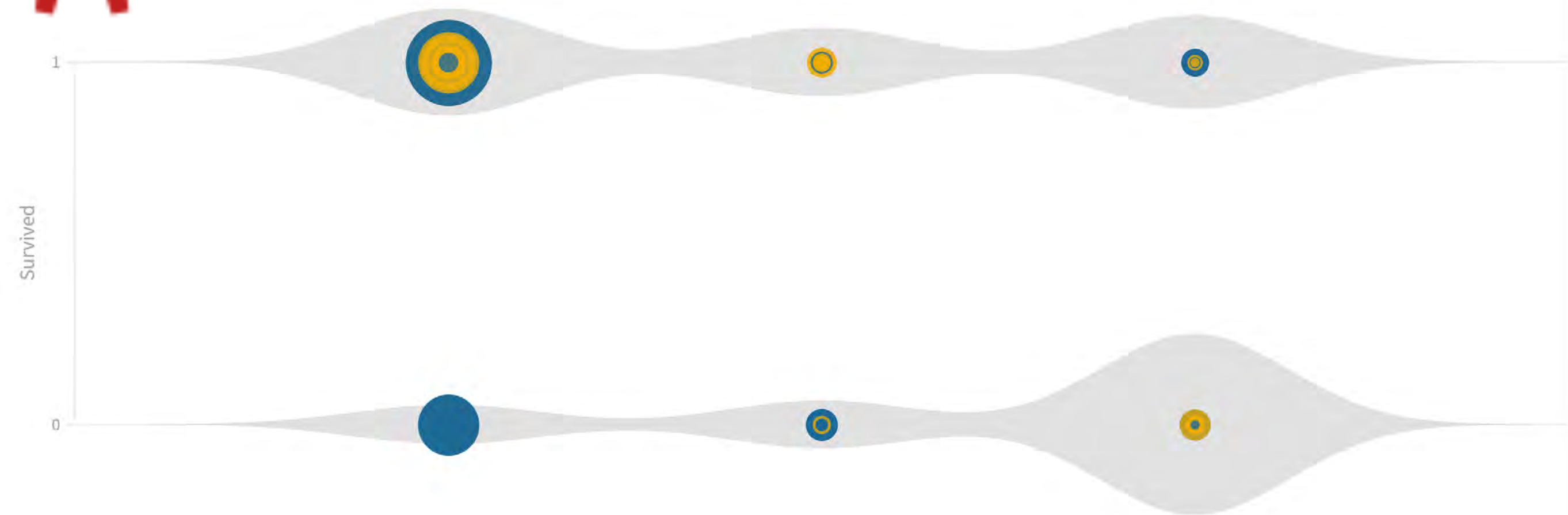


Flourish.studio



The screenshot shows the Flourish.studio interface with a data table and a visualization. The data table is titled "Titanic" and has columns for Survived, Pclass, Pkzss-Neighborhood, Name, and Sex. The visualization is a violin plot showing the distribution of Pclass for Survived and Not Survived.

	A	B	C	D	E
1	Survived	Pclass	Pkzss-Neighborhood	Name	Sex
2	0	3		Mr. Owen Harris Braund	male
3	1	1		Mrs. John Bradley (Florence Briggs Thayer) Cumings	female
4	1	3		Miss. Laina Heikkinen	female
5	1	1		Mrs. Jacques Heath (Lily May Peel) Futrelle	female
6	0	3		Mr. William Henry Allen	male
7	0	3		Mr. James Moran	male
8	0	1		Mr. Timothy J McCarthy	male
9	0	3		Master. Gosta Leonard Falsun	male
10	1	3		Mrs. Oscar W (Elsabeth Vilhelmina Berg) Johnson	female
11	1	2		Mrs. Nicholas (Adele Achen) Nazzer	female
12	1	3		Miss. Marguerite Ryn Sandstrom	female
13	1	1		Miss. Elizabeth Bunnell	female
14	0	3		Mr. William Henry Saunderscock	male
15	0	3		Mr. Anders Johan Andersson	male
16	0	3		Miss. Hilda Amanda Adolfsa Westrom	female



Observable

Make sense of the world
with data, **together**

Get started with Observable

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Share insights with the world.

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Staff picks

View all →

1. Fork a template

2. Upload your data

3. Edit any part

Introducing Observable
Templates!

Deepti Srivastava in Observable

How to use and
customize the
Survey Report
Builder
Template

Survey Report Builder

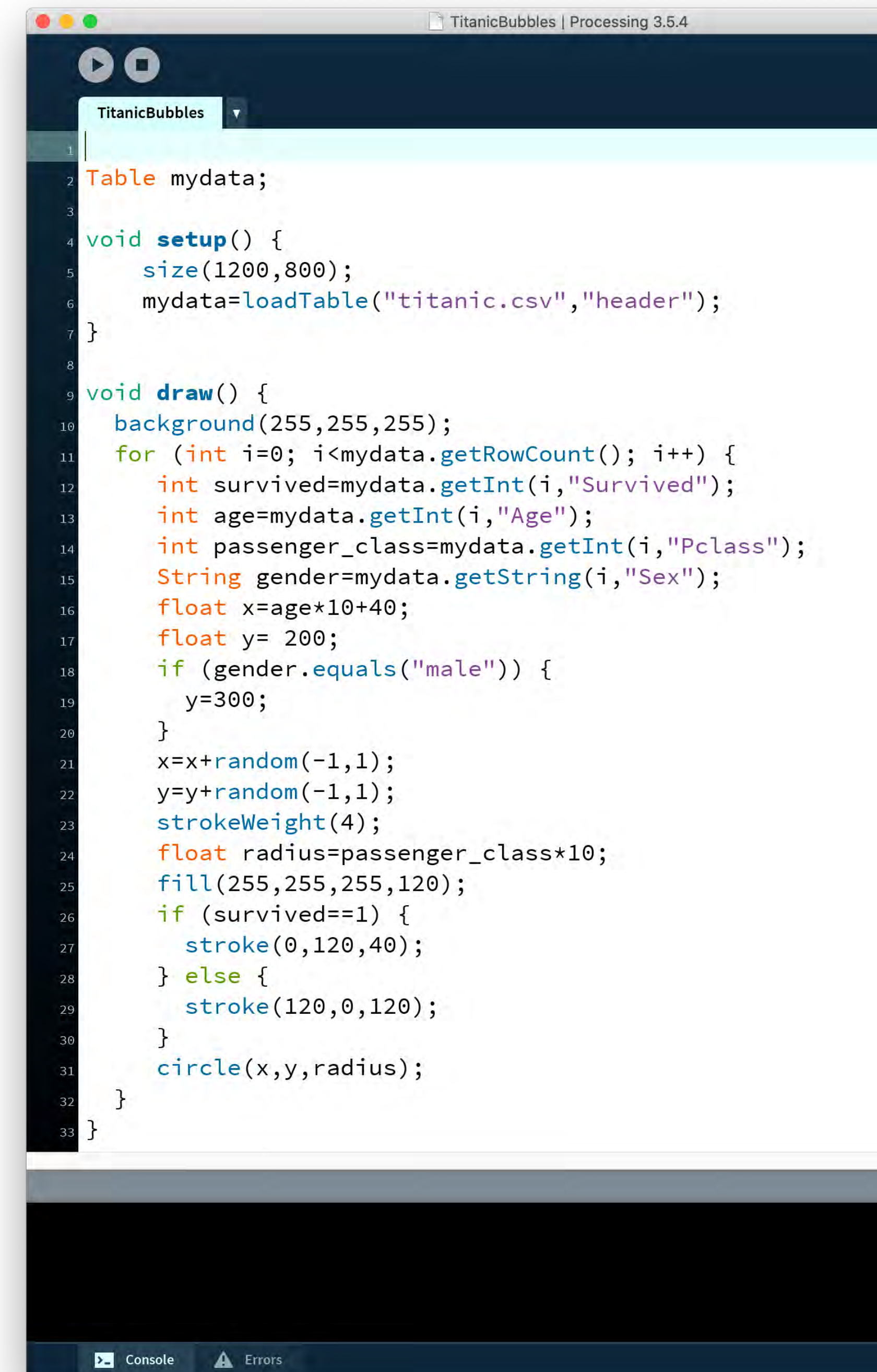
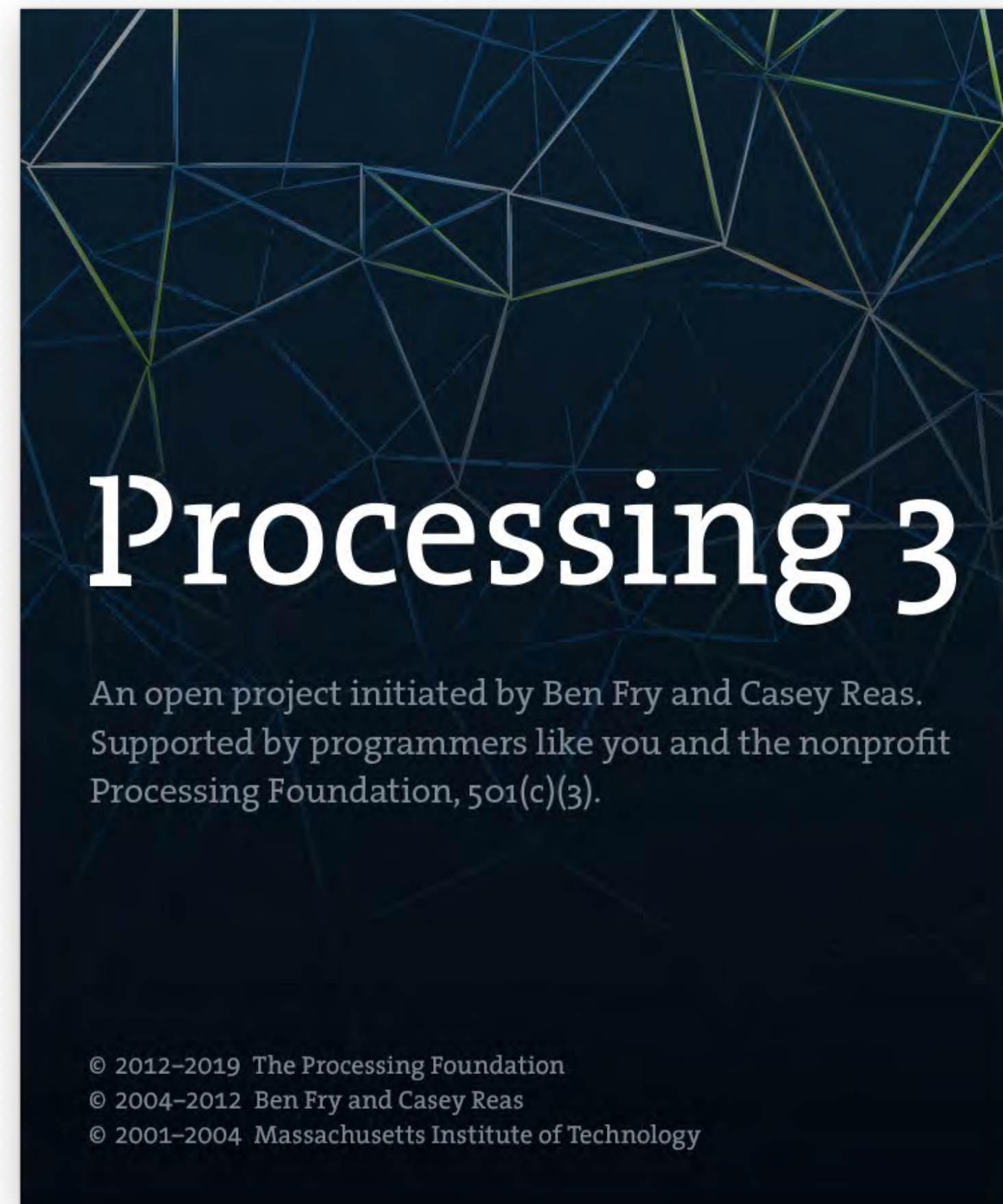
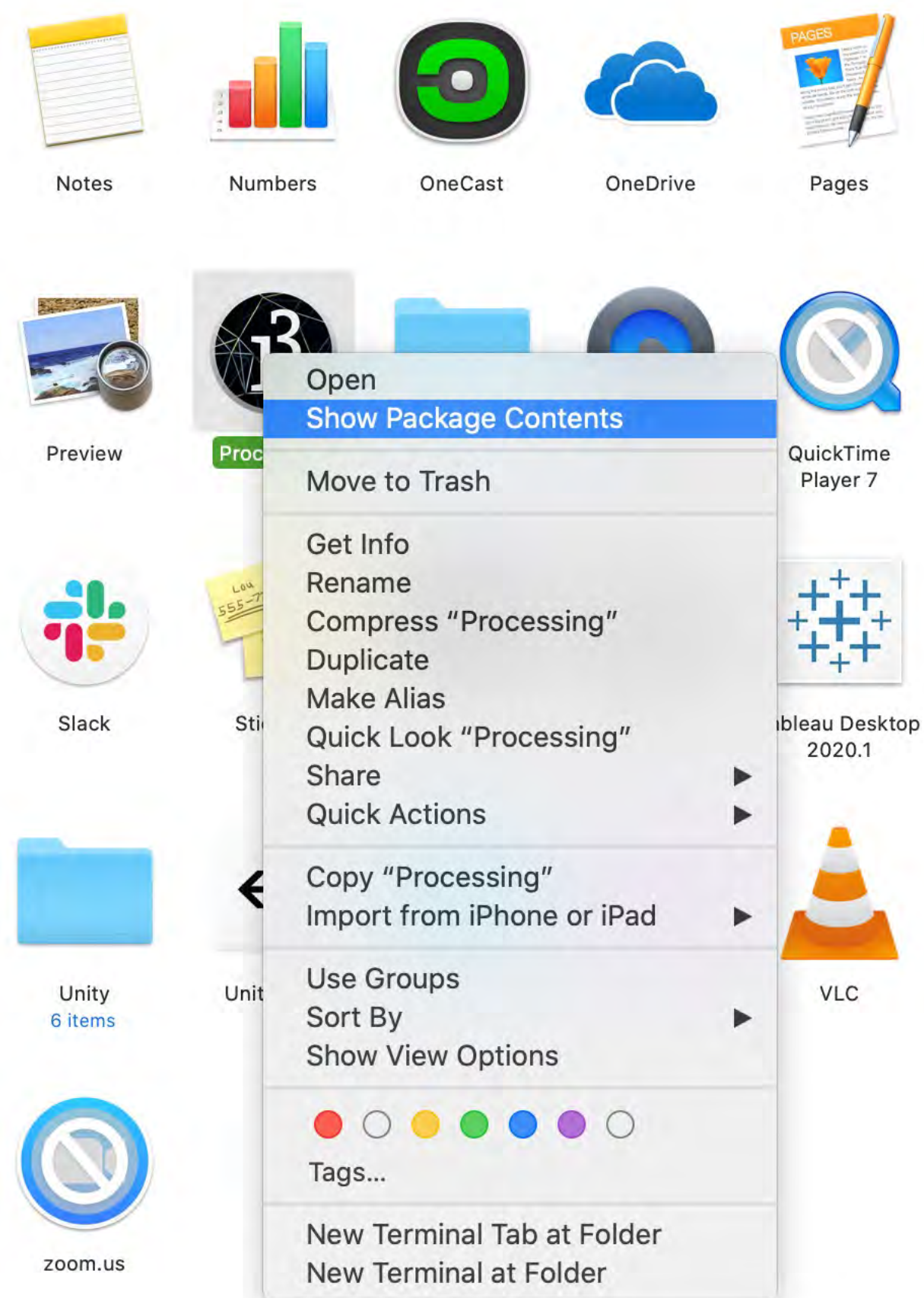
User Research: Survey Report
Builder Tutorial

Ian Johnson in Observable

Observable Plot

Mike Bostock in Observable

Get started with Observable Plot: interactive
examples and documentation



PSIS*



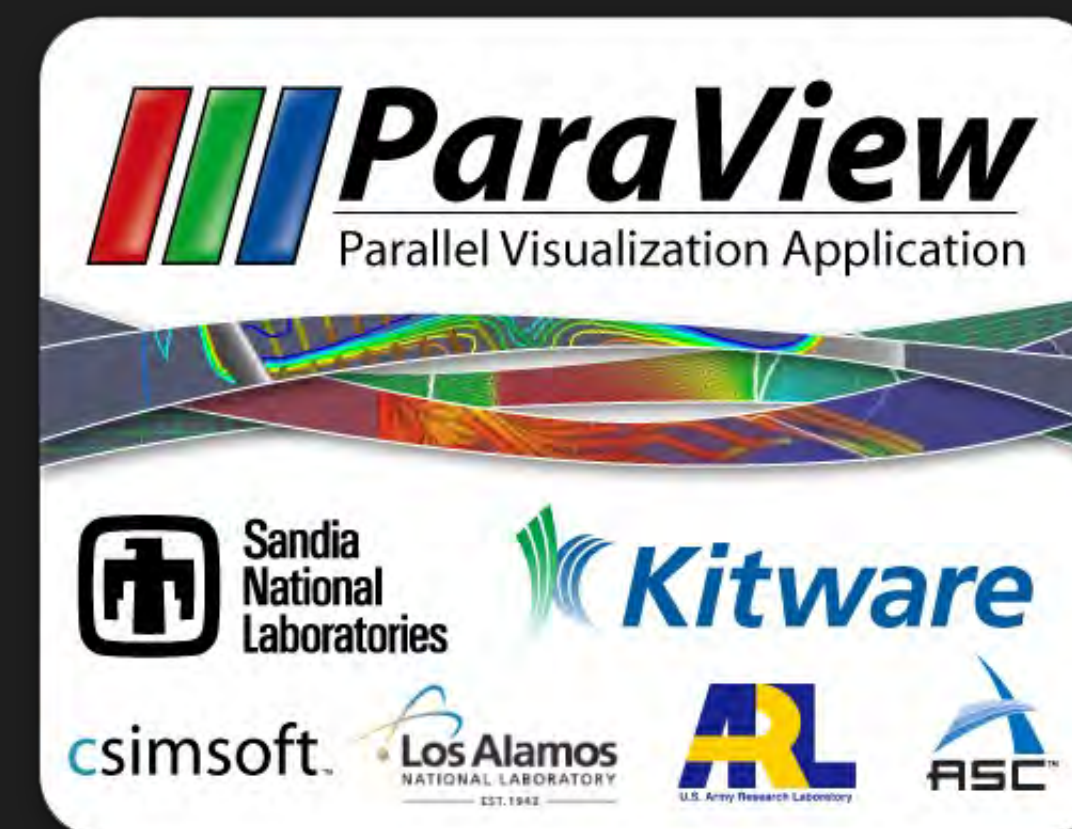
go to editor.p5js.org

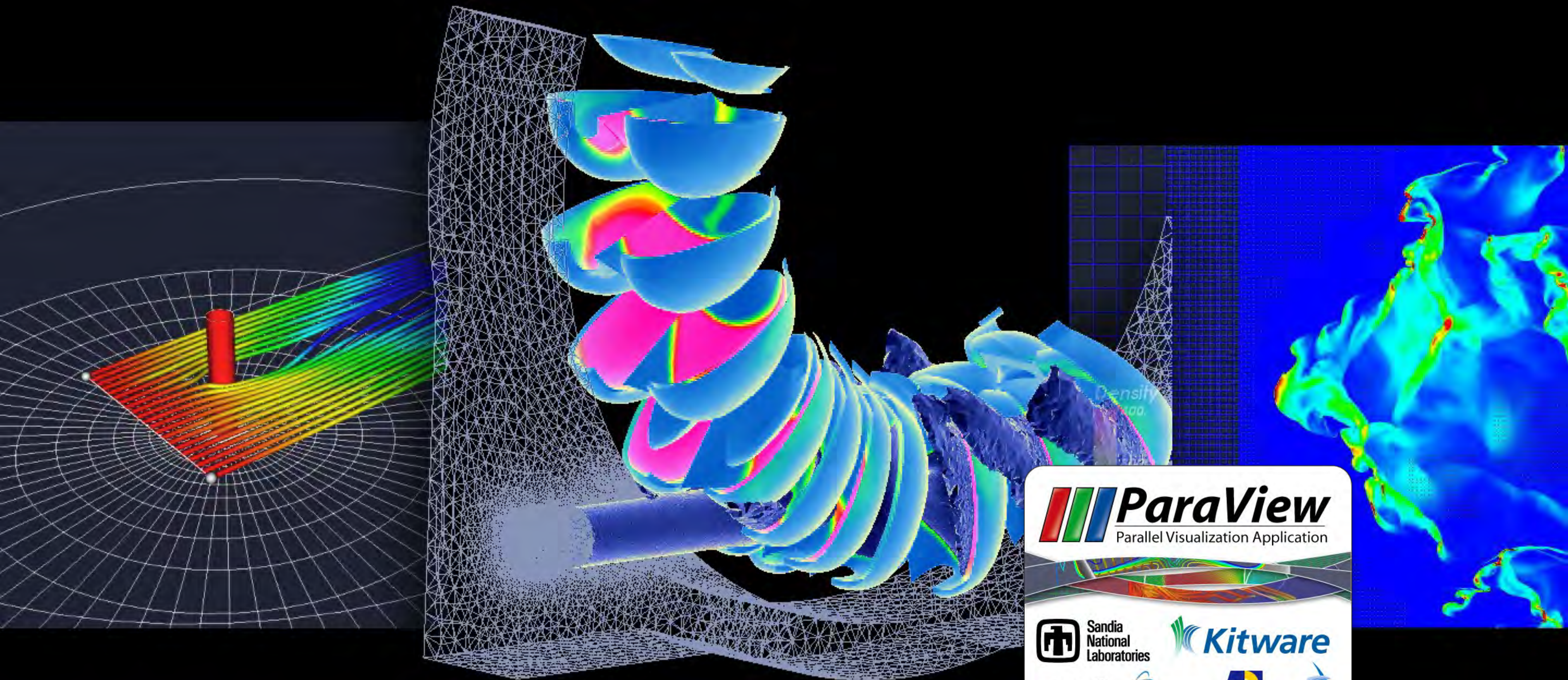
LOGIN

this is P5JS









 **ParaView**
Parallel Visualization Application



csimsoft.



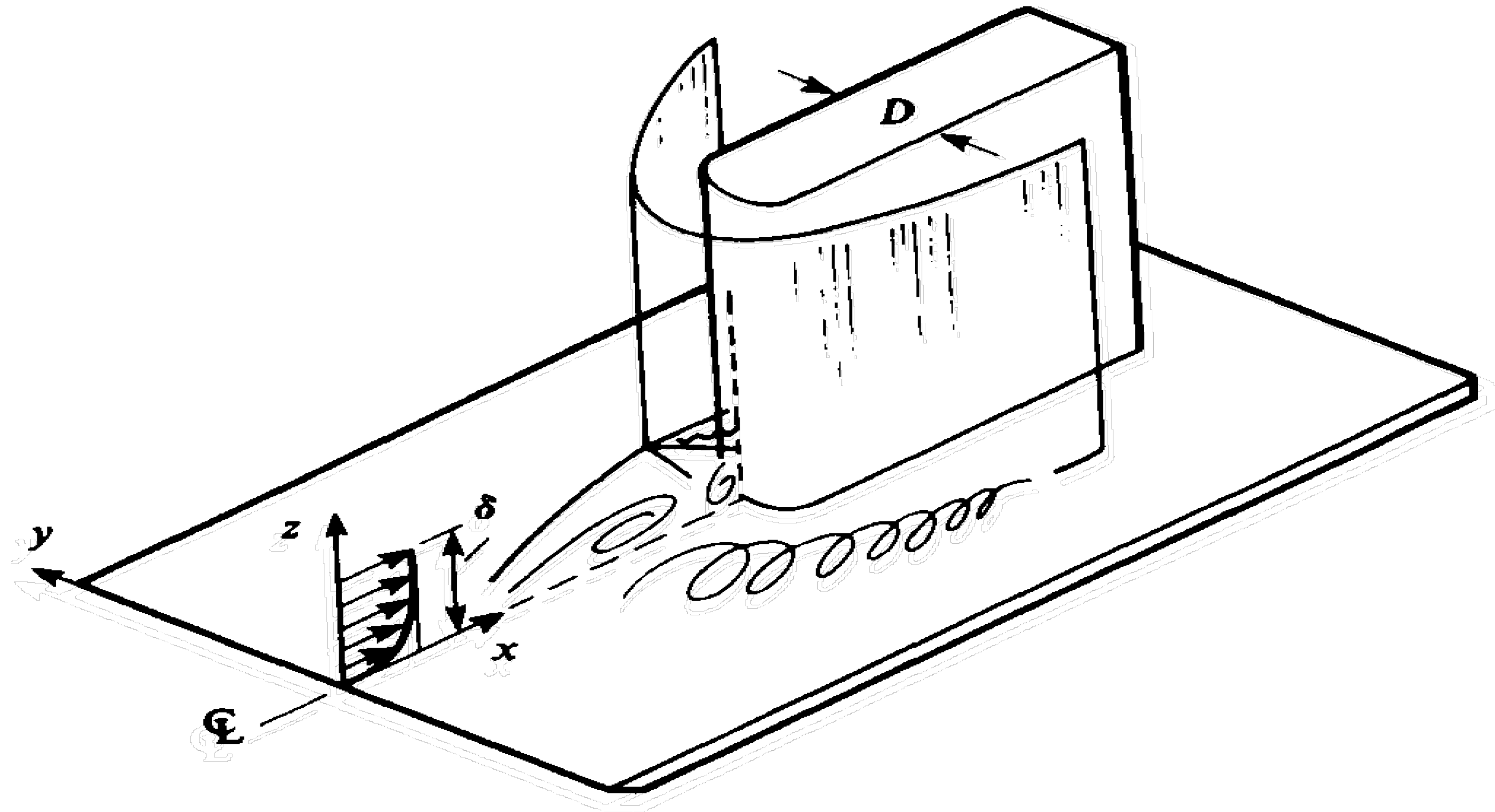


FIGURE 1. Blunt fin on a flat plate.

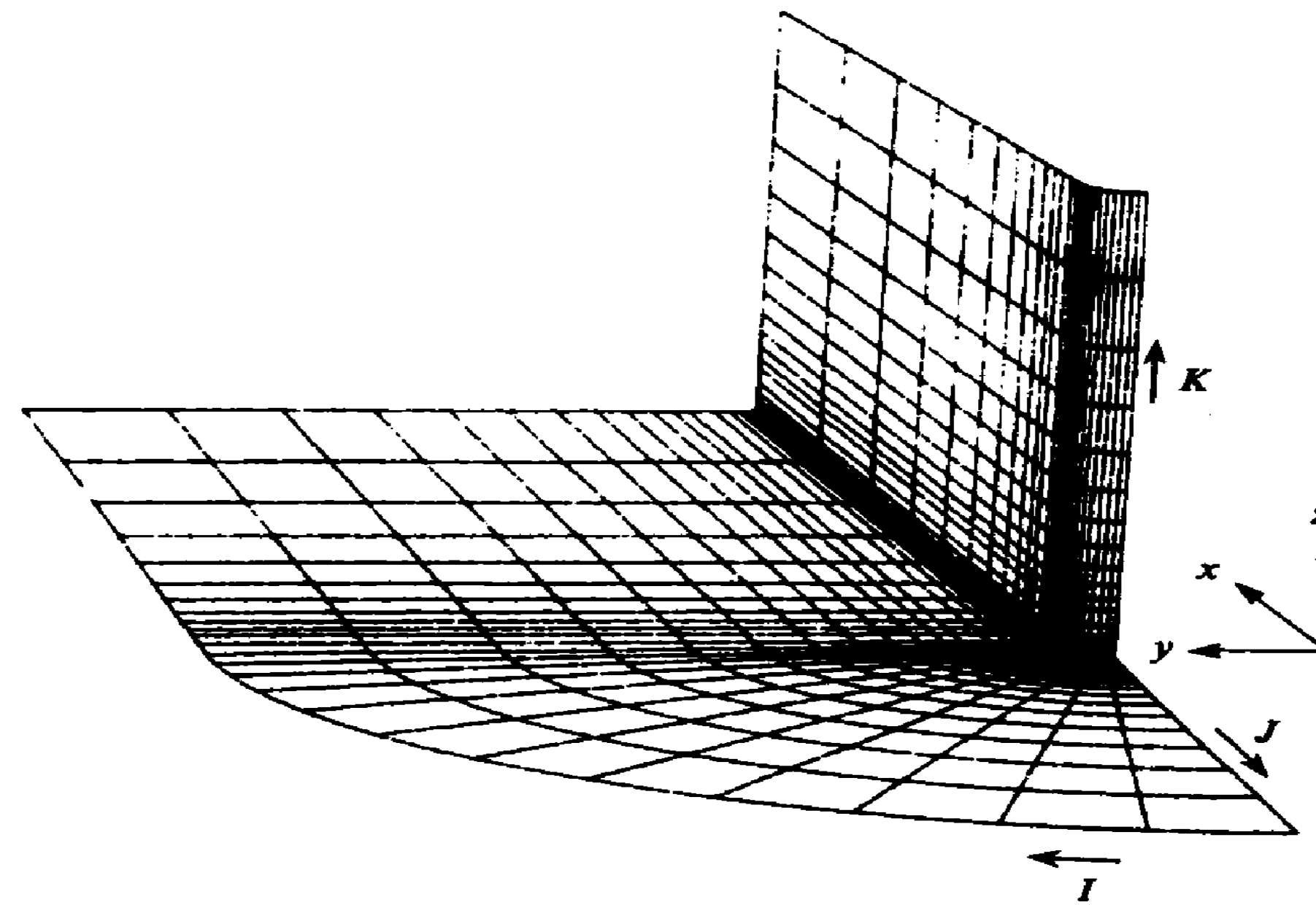
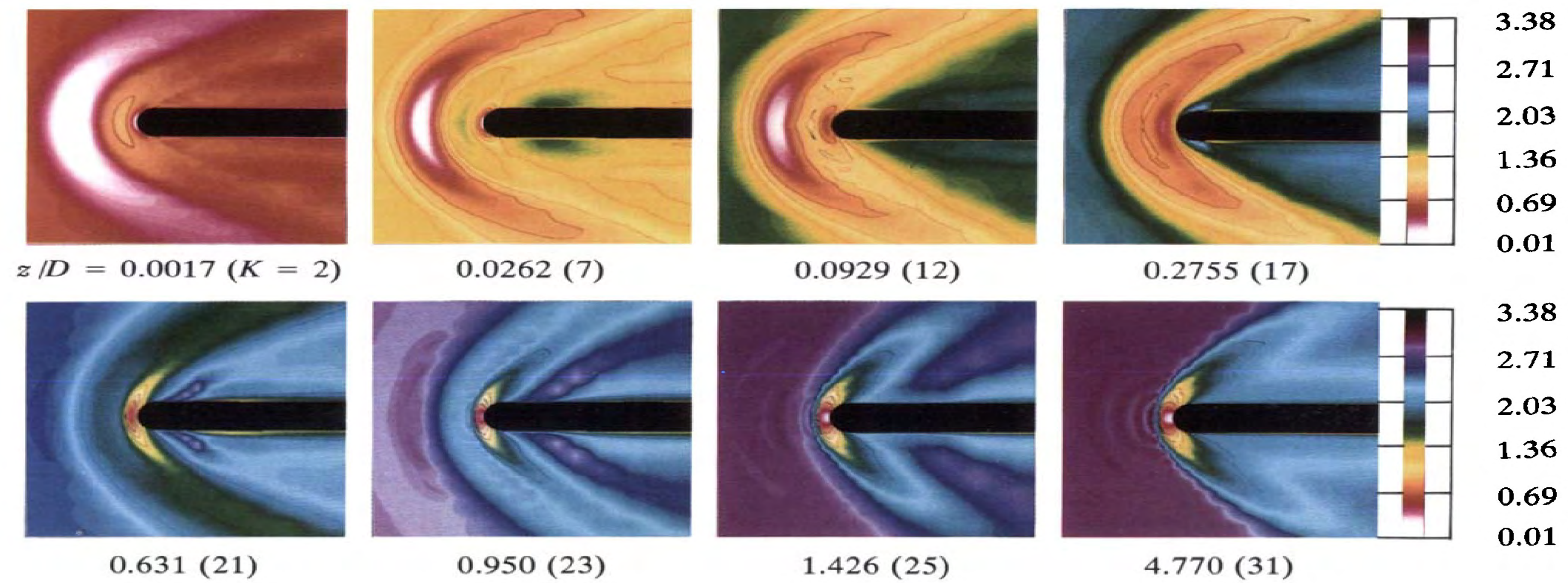
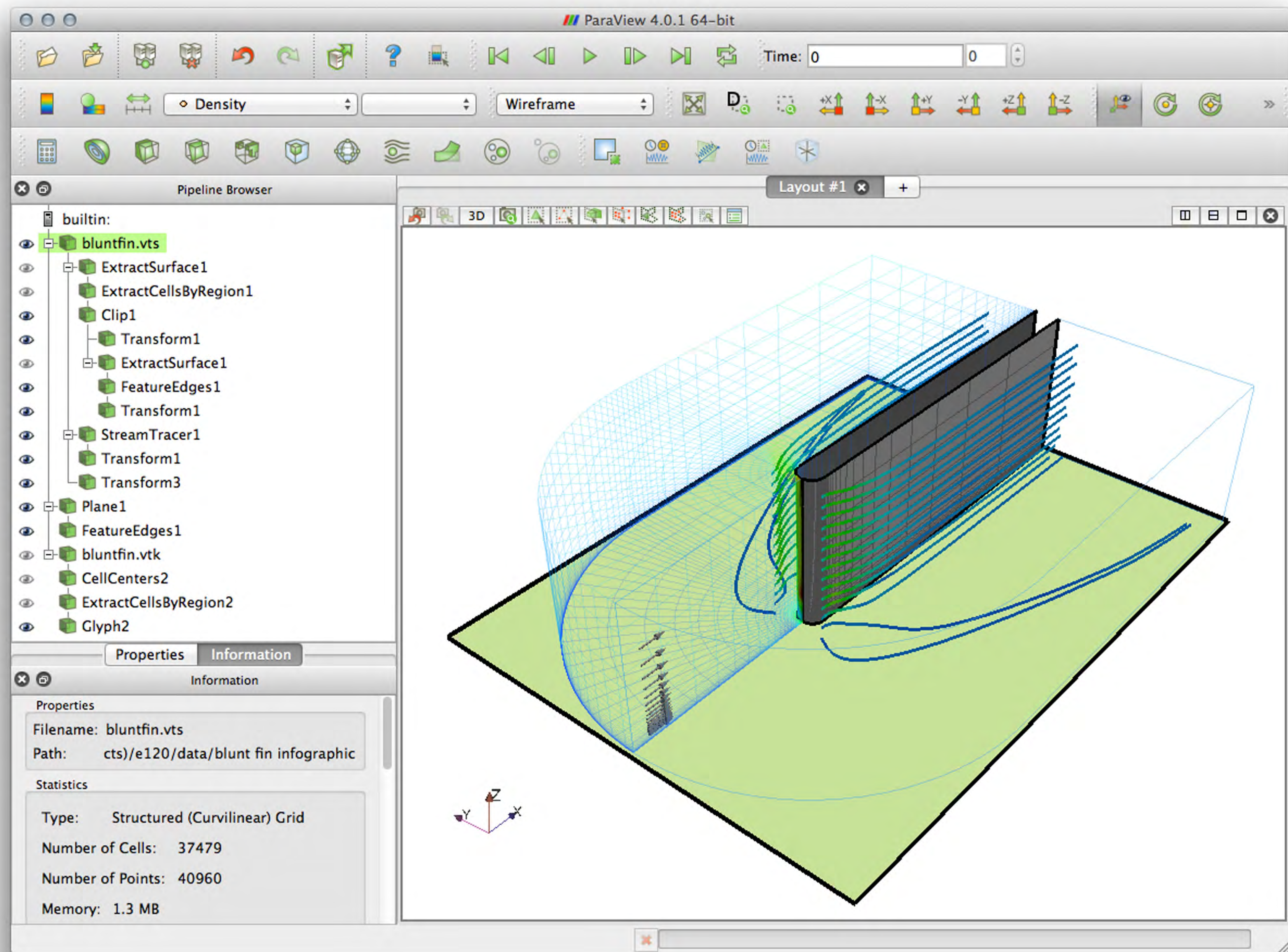
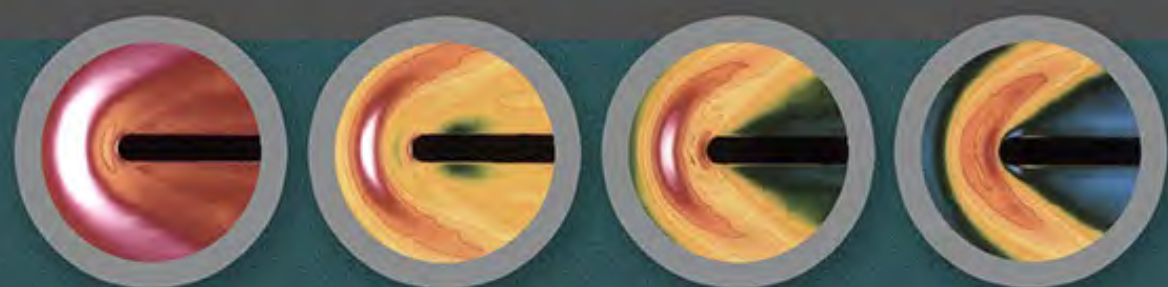


FIGURE 2. Mesh distribution on blunt fin and flat plate.

FIGURE 20. Mach number at various $z = \text{constant}$ planes.







MACH NUMBER AT VARIOUS



CONSTANT (Z=) PLANES

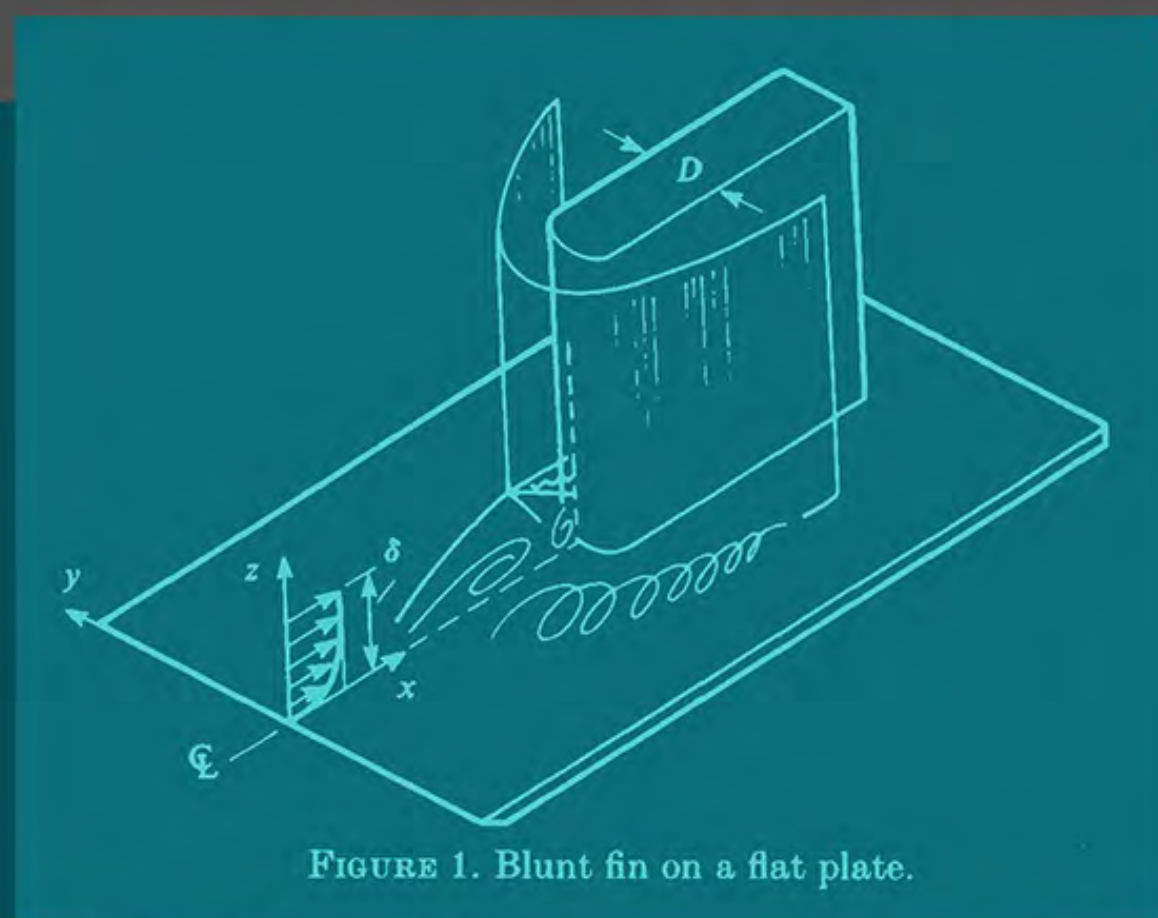
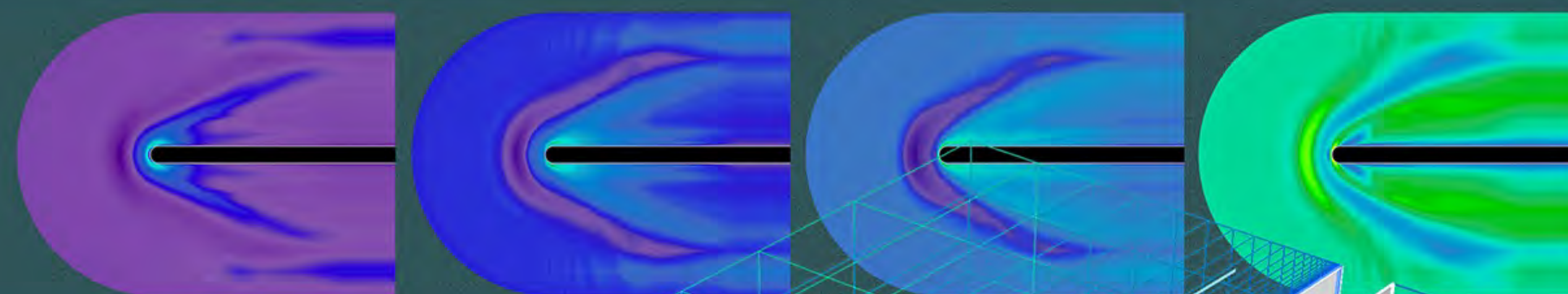


FIGURE 1. Blunt fin on a flat plate.

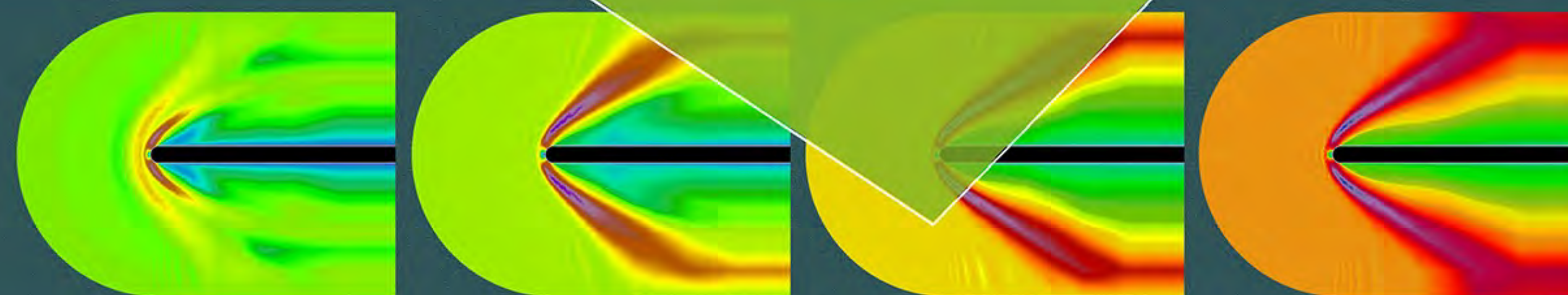
**BLUNT-FIN-INDUCED
SHOCK-WAVE
AND TURBULENT
BOUNDARY-LAYER INTERACTION**

visualized with

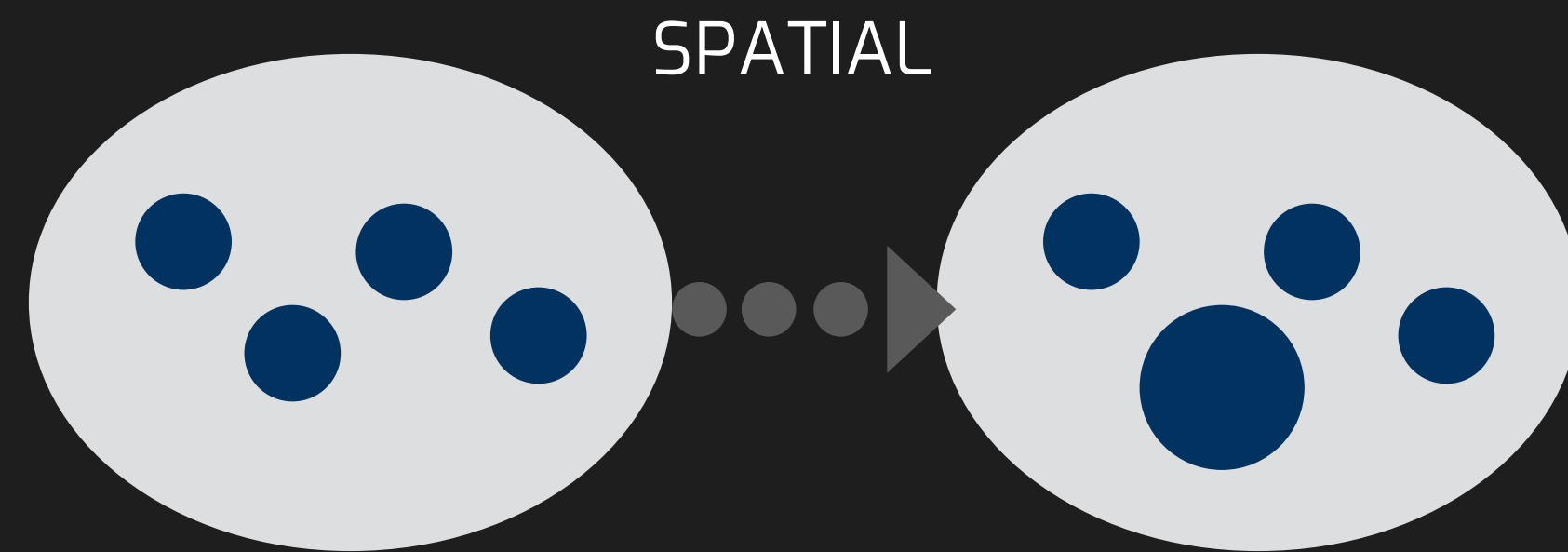
PARAVIEW



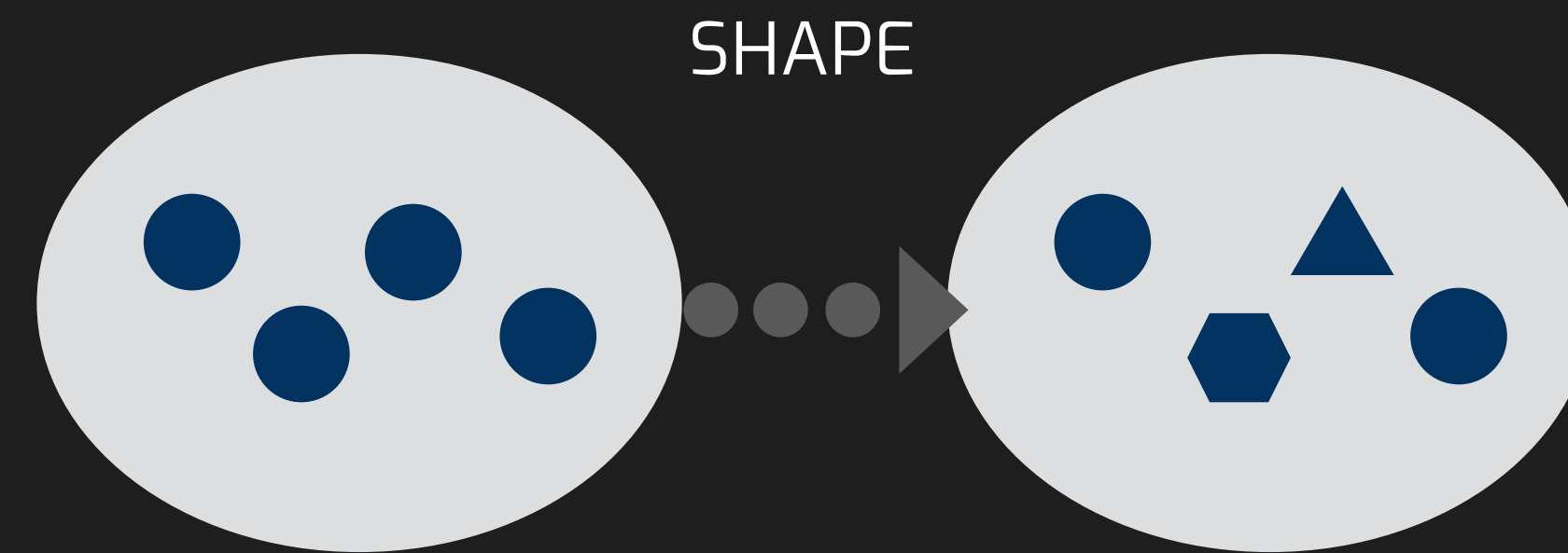
```
builtin:  
├─ bluntfin.vts  
│   ├─ ExtractSurface1  
│   │   └─ ExtractCellsByRegion1  
│   │       └─ Clip1  
│   │           └─ Transform1  
│   └─ ExtractSurface1  
│       └─ FeatureEdges1  
│           └─ Transform1  
├─ StreamTracer1  
│   └─ Transform1  
│       └─ Transform3  
├─ Plane1  
│   └─ FeatureEdges1  
├─ bluntfin.vtk  
│   └─ CellCenters2  
│       └─ ExtractCellsByRegion2  
└─ Glyph2
```



bit.ly/caltechvizdata

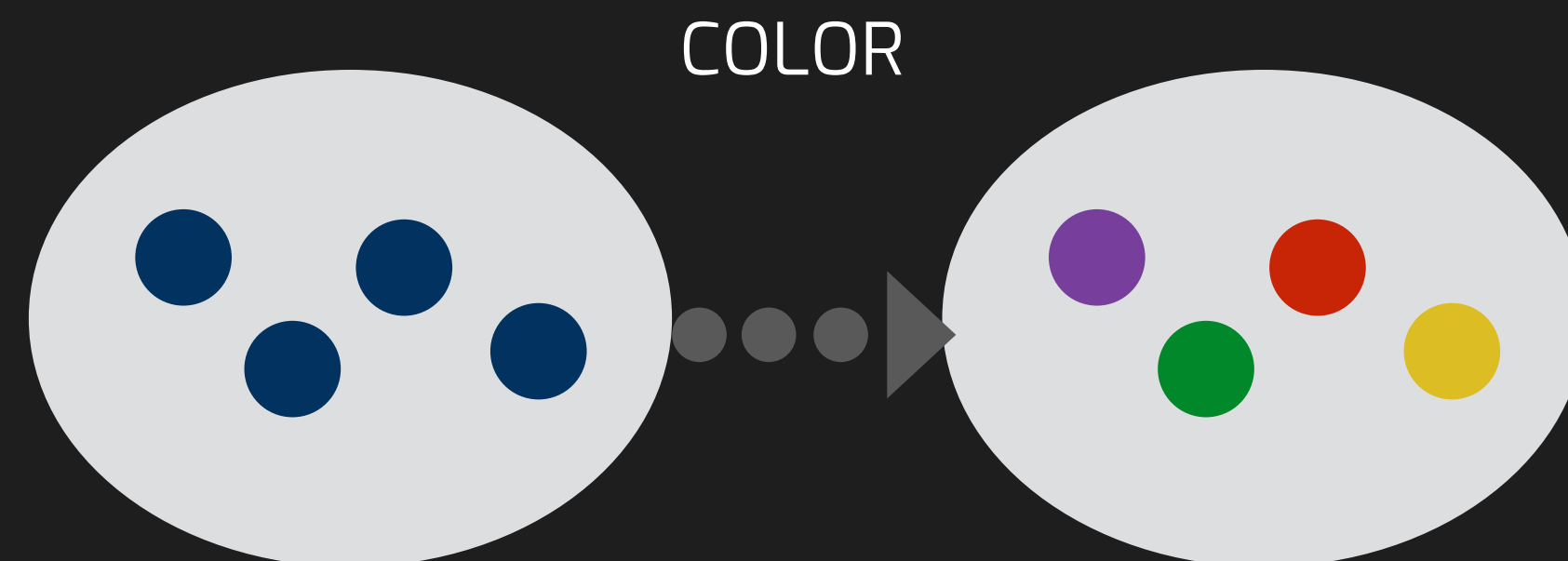


position | scale | orientation

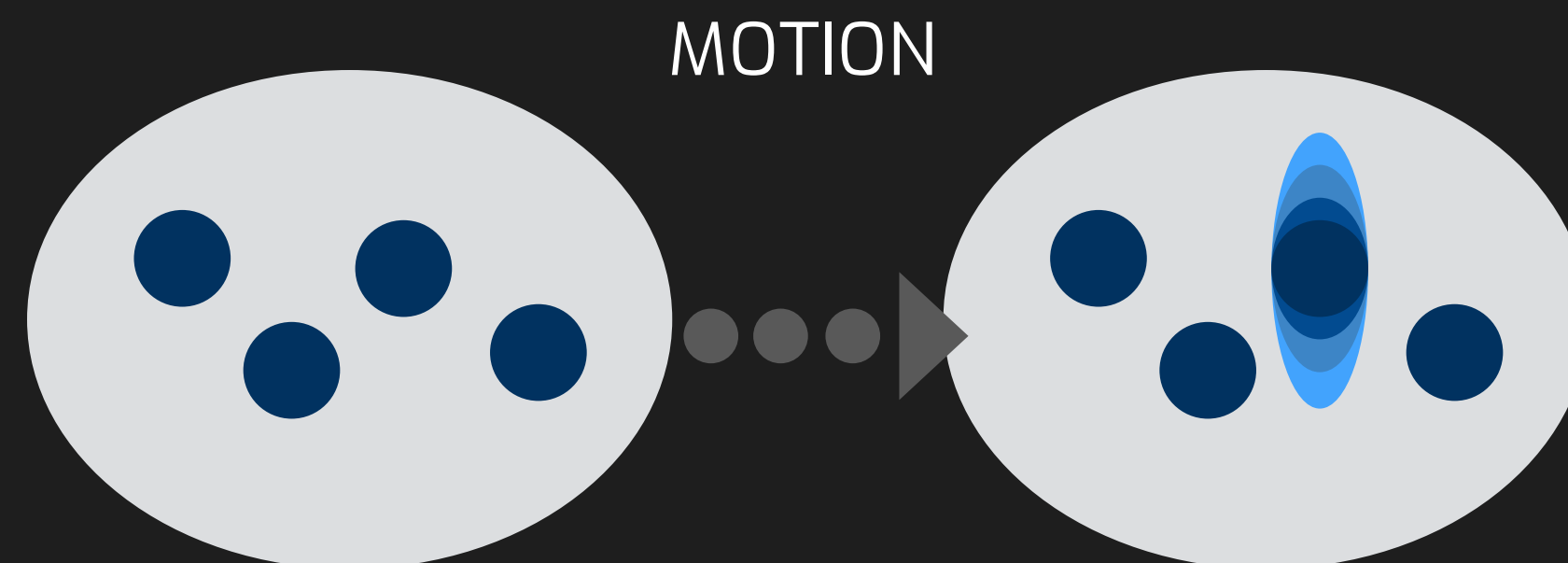


distinctive glyphs | bumps | points | whiskers

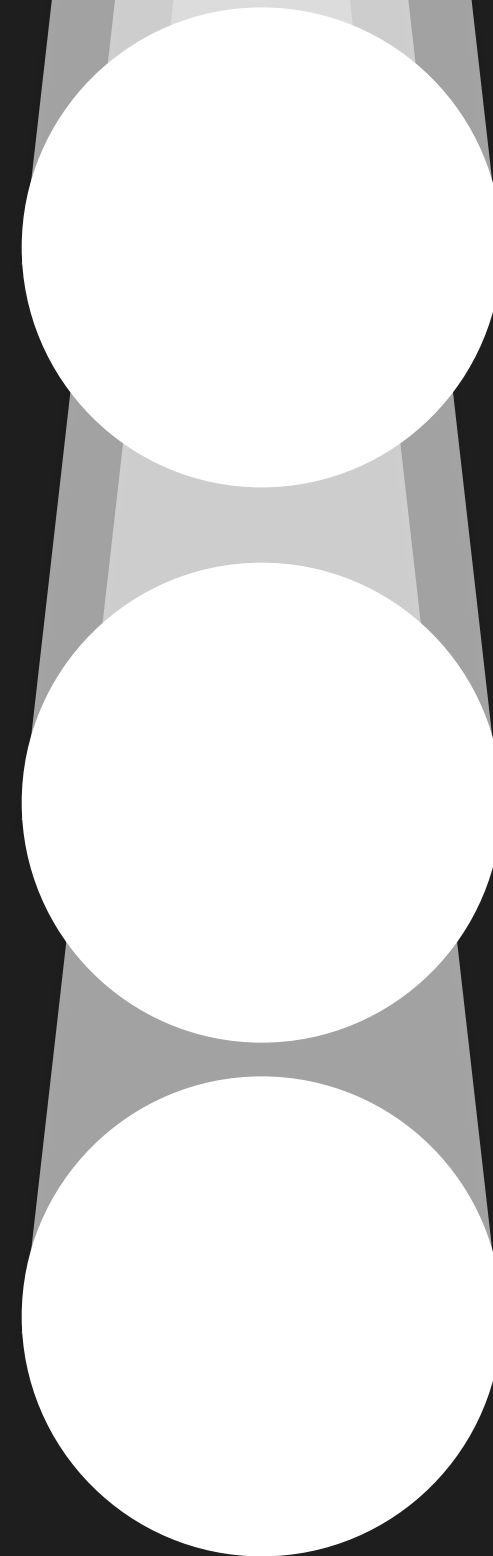
BASIC DATA ENCODING



luminosity | hue | saturation | texture



vibration | rotation | deformation

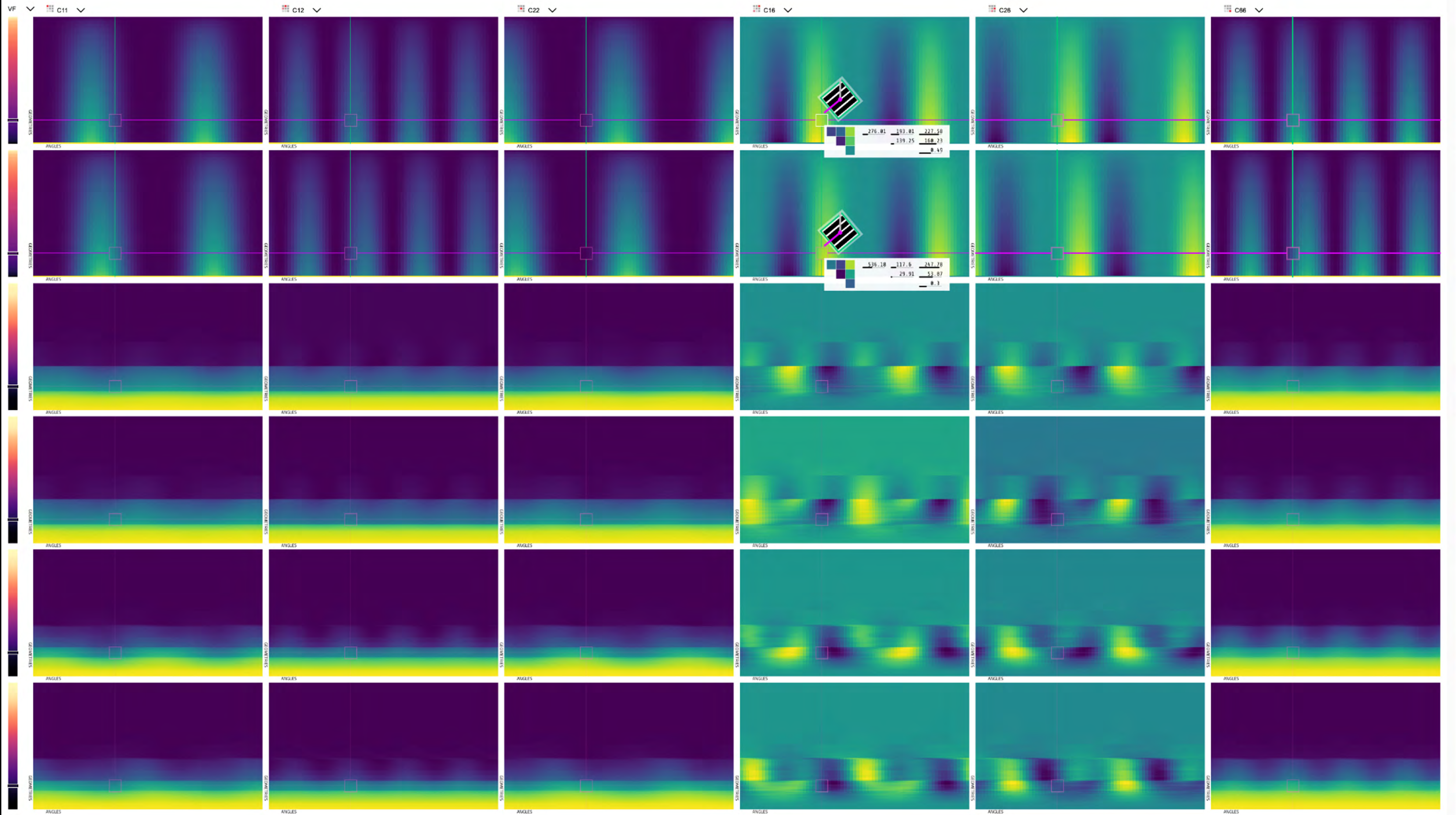


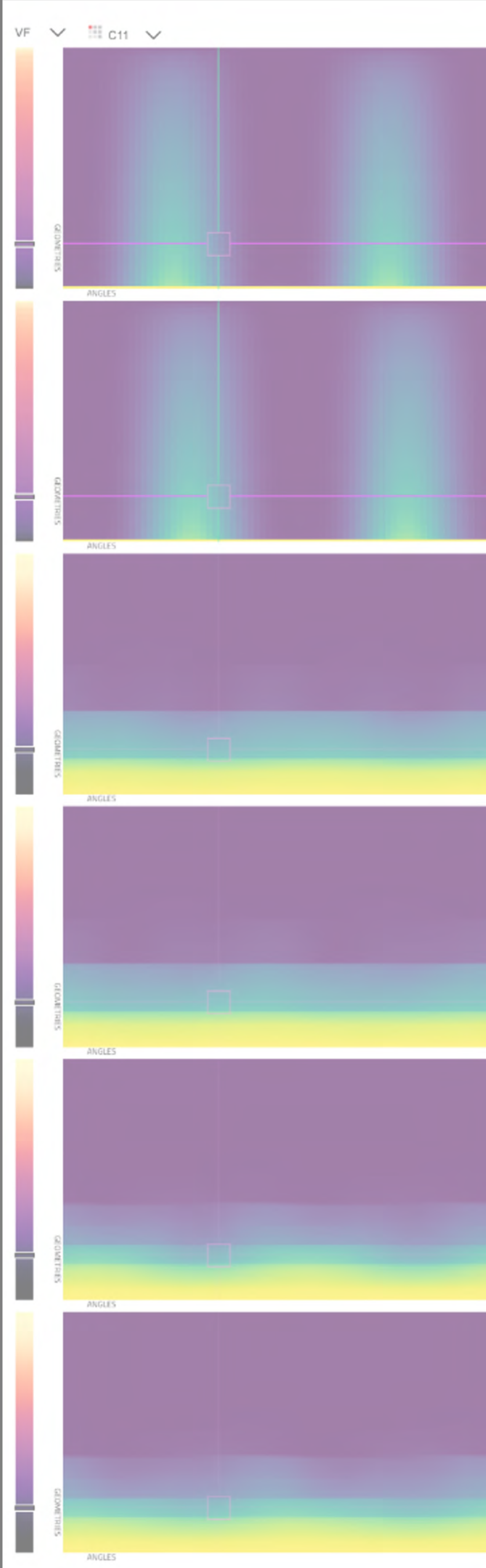
QUICK INSPECTION

ANALYSIS TOOL

BATCH/DISCRIMINATION TOOL

PRAGMATIC VISUALIZATION PRECEPT | **LEVEL OF ENGAGEMENT ■**





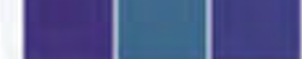
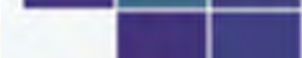
GEOMETRIES

GEOMETRIES

ANGLES

ANGLES

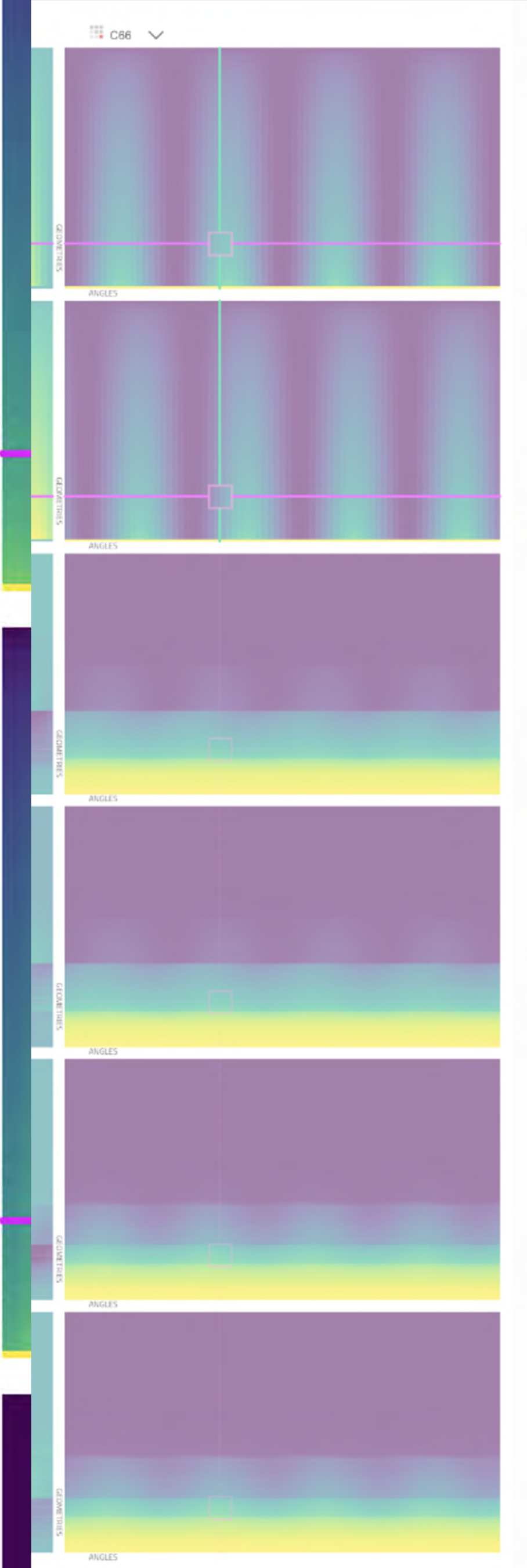


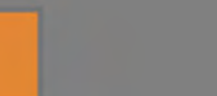
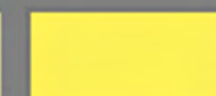
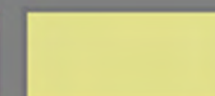
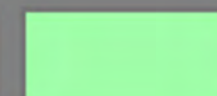
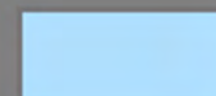
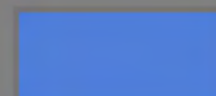
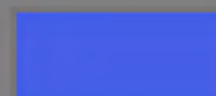
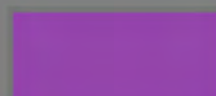
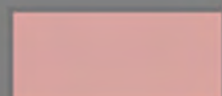
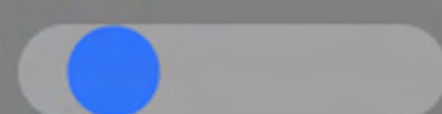
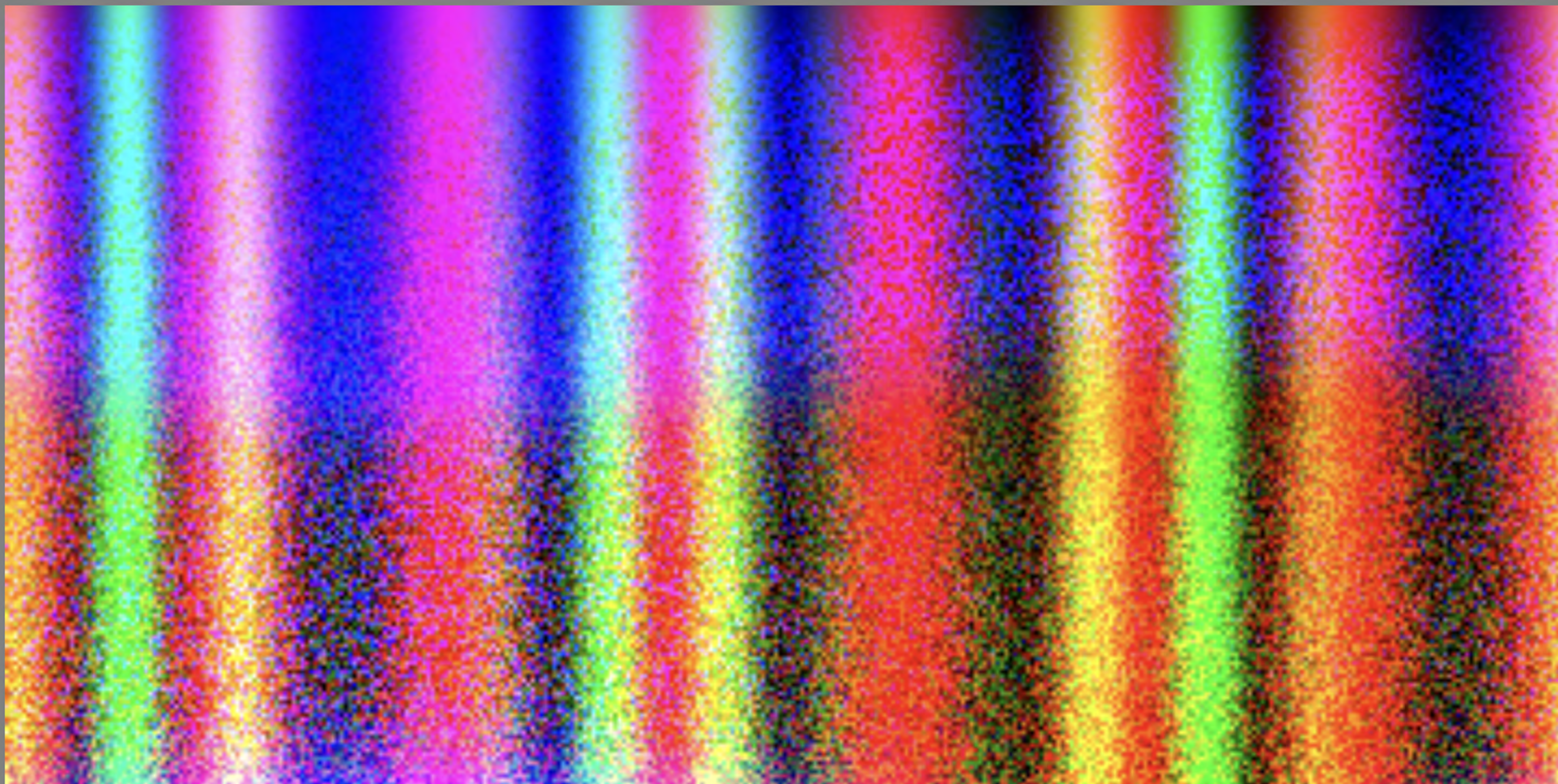
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	<u>201.69</u>	<u>-196.9</u>	
		<u>0.51</u>	

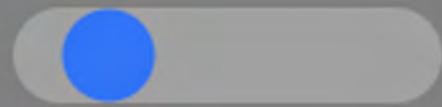
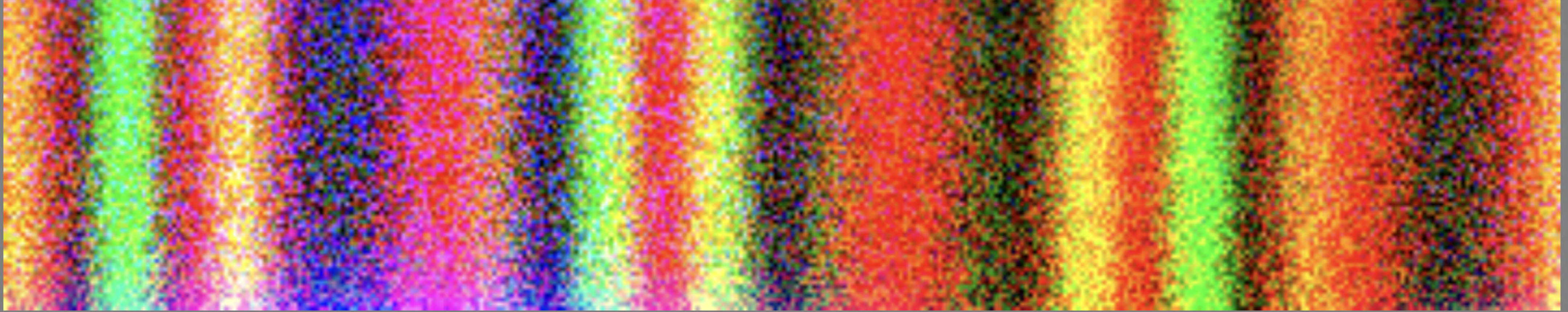
	<u>54.02</u>	<u>149.73</u>	<u>-85.26</u>
	<u>447.82</u>	<u>-255.78</u>	
		<u>0.38</u>	

GEOMETRIES

GEOMETRIES







candy_fuzzy_c7_s3c13_s1

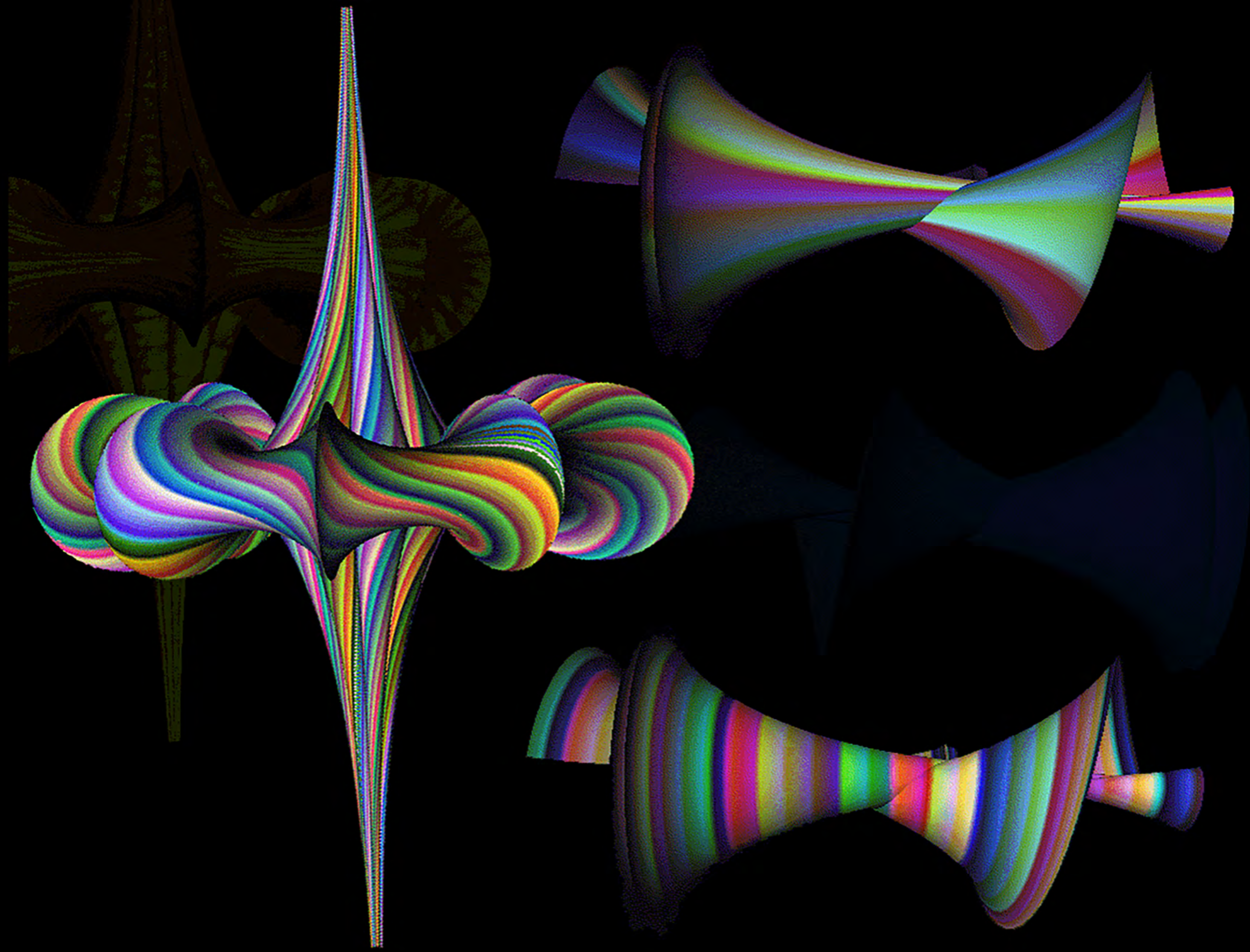


☐ $\cos(\ln(x^7)) + \sin(y) * \text{random}(-.5, 2) / 2$

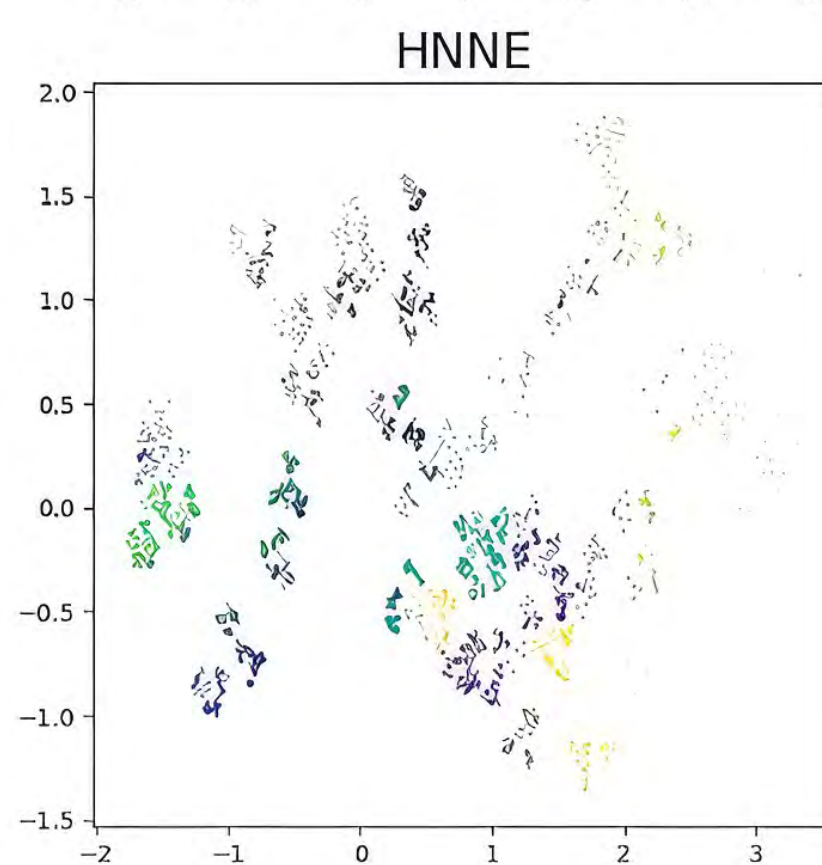
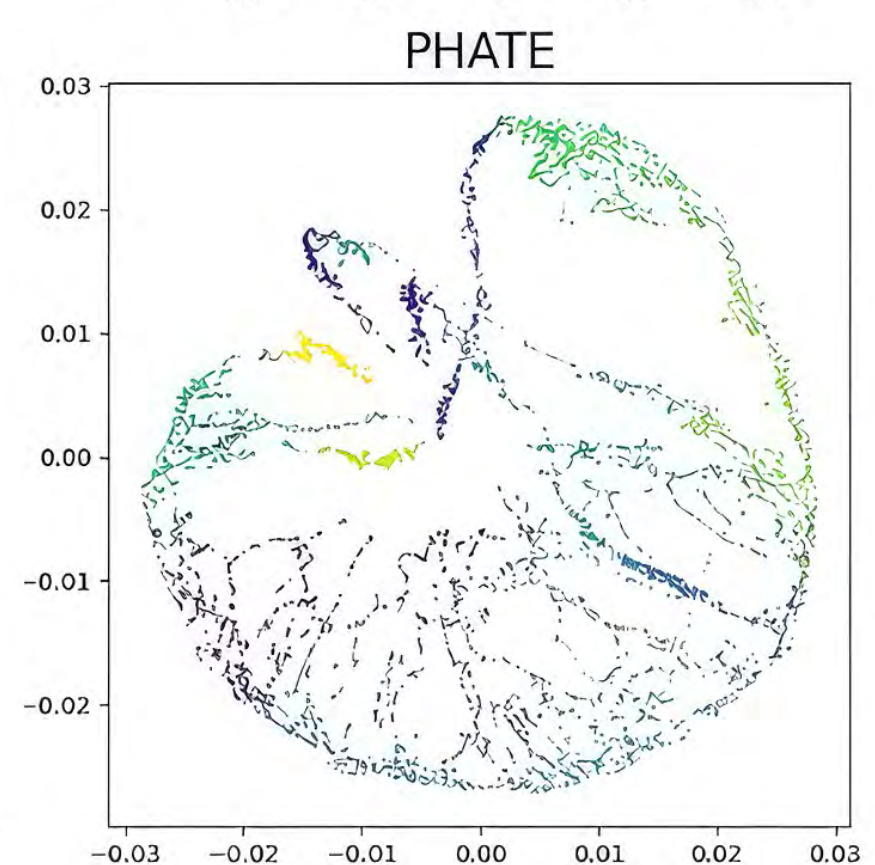
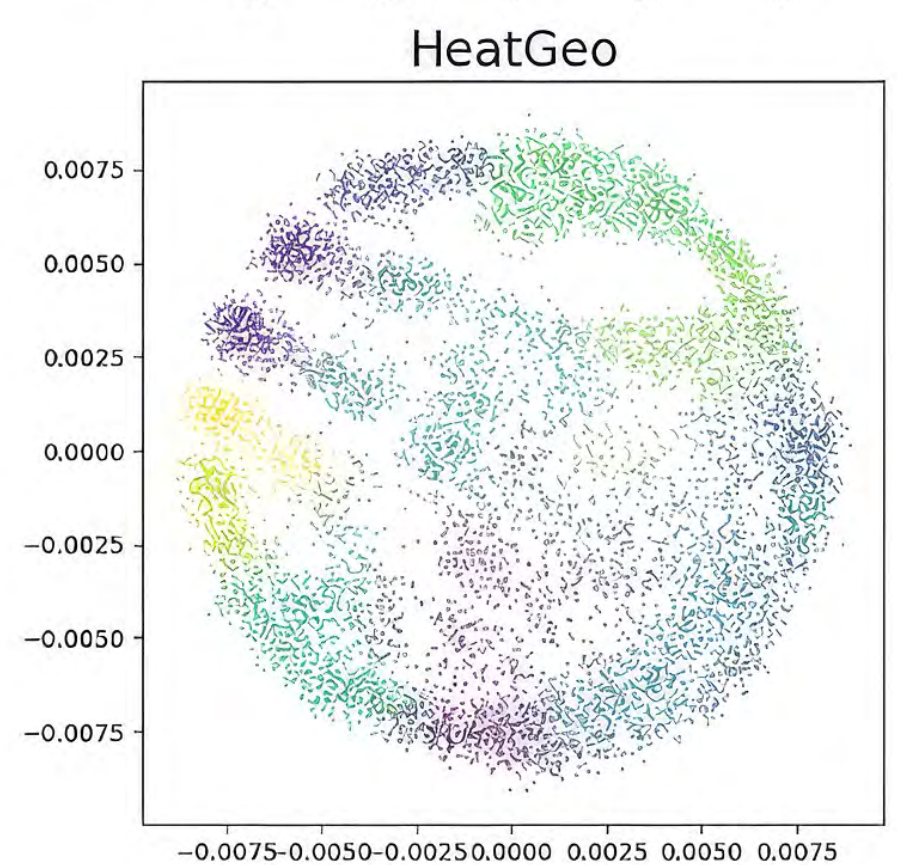
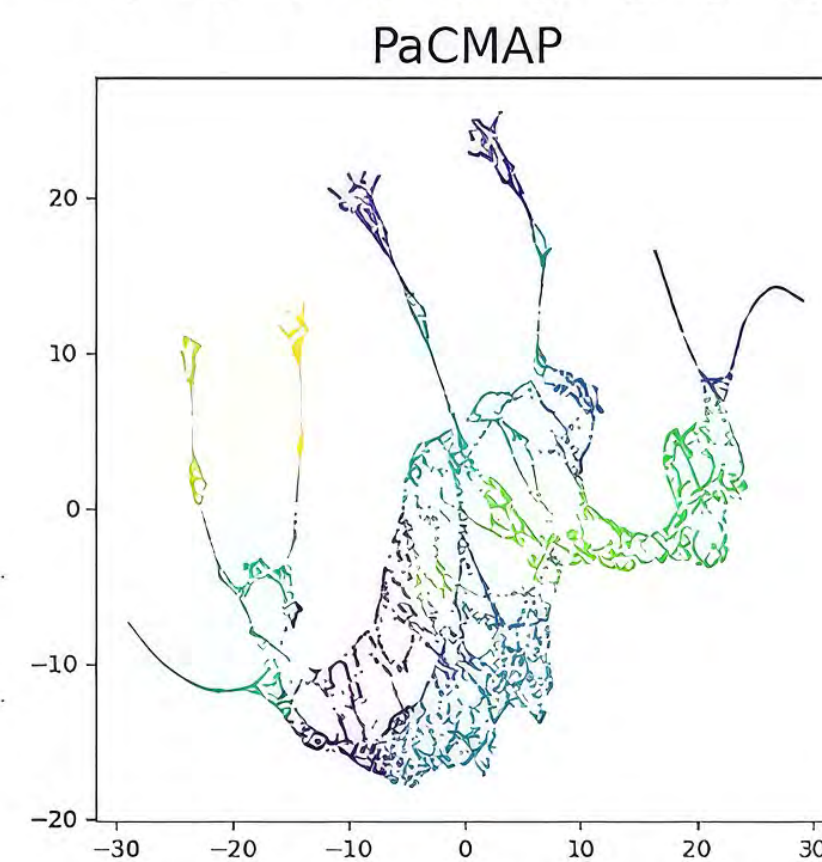
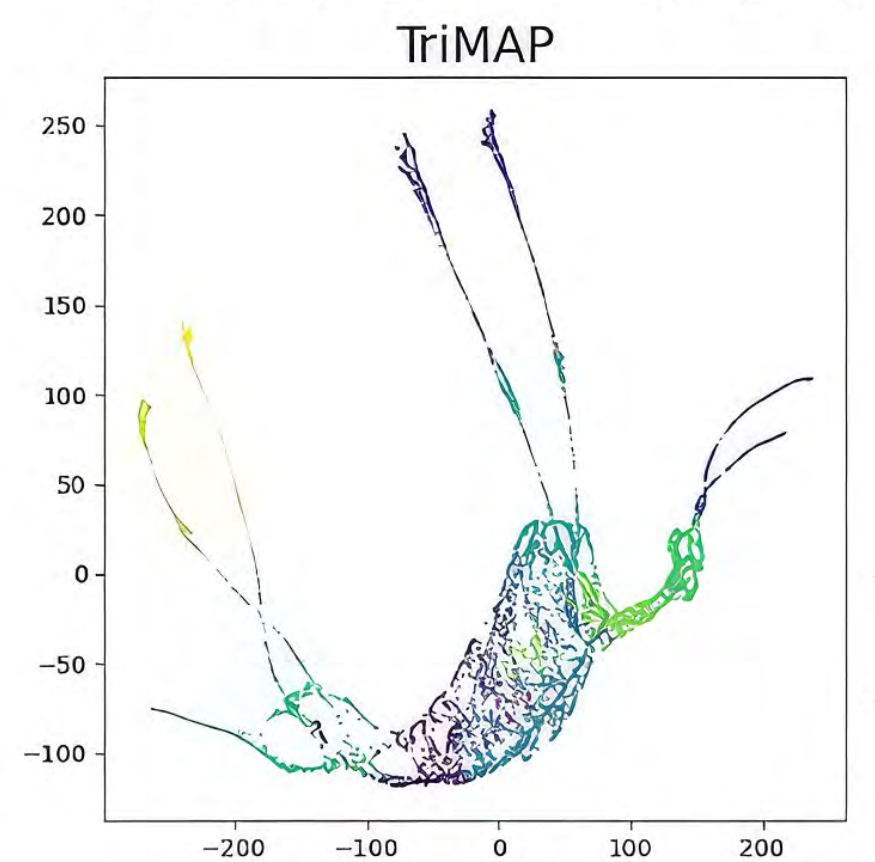
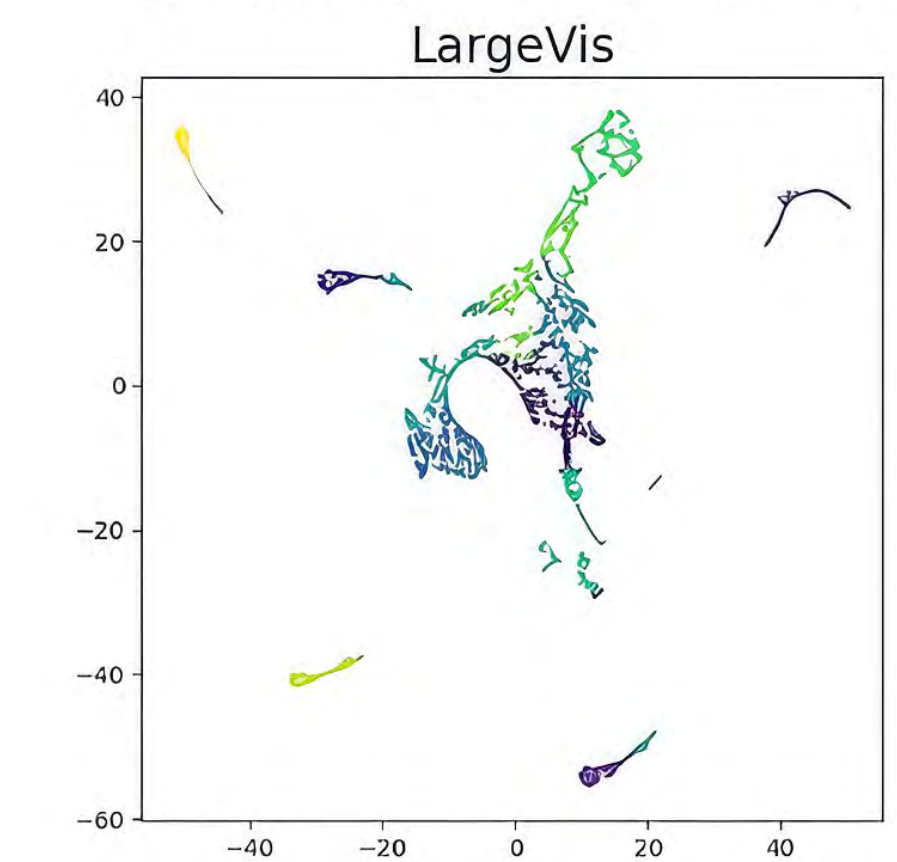
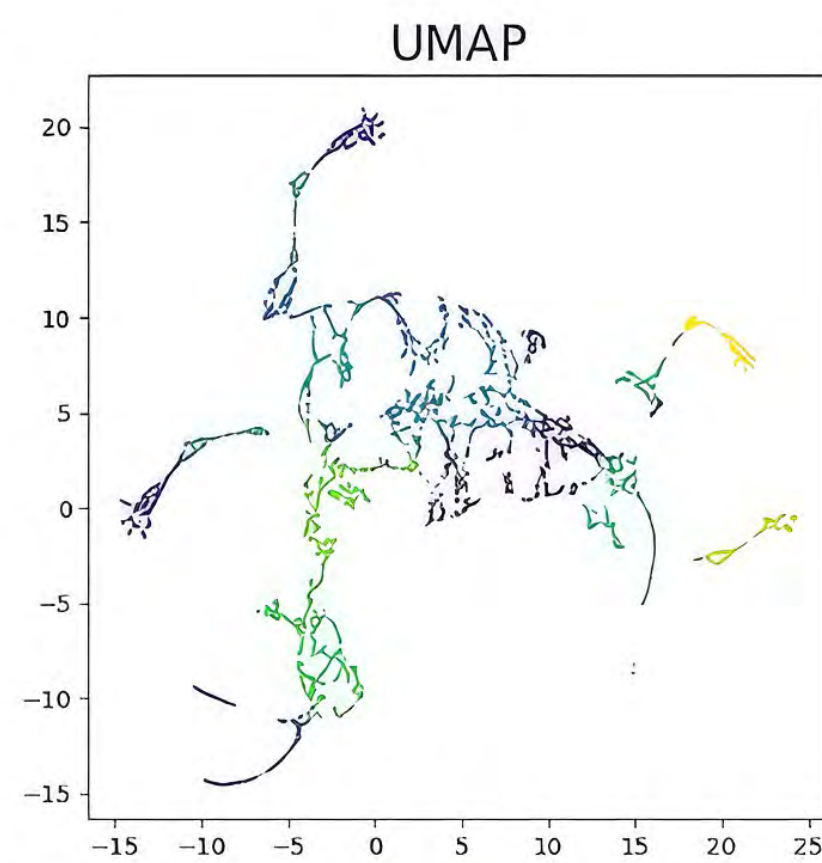
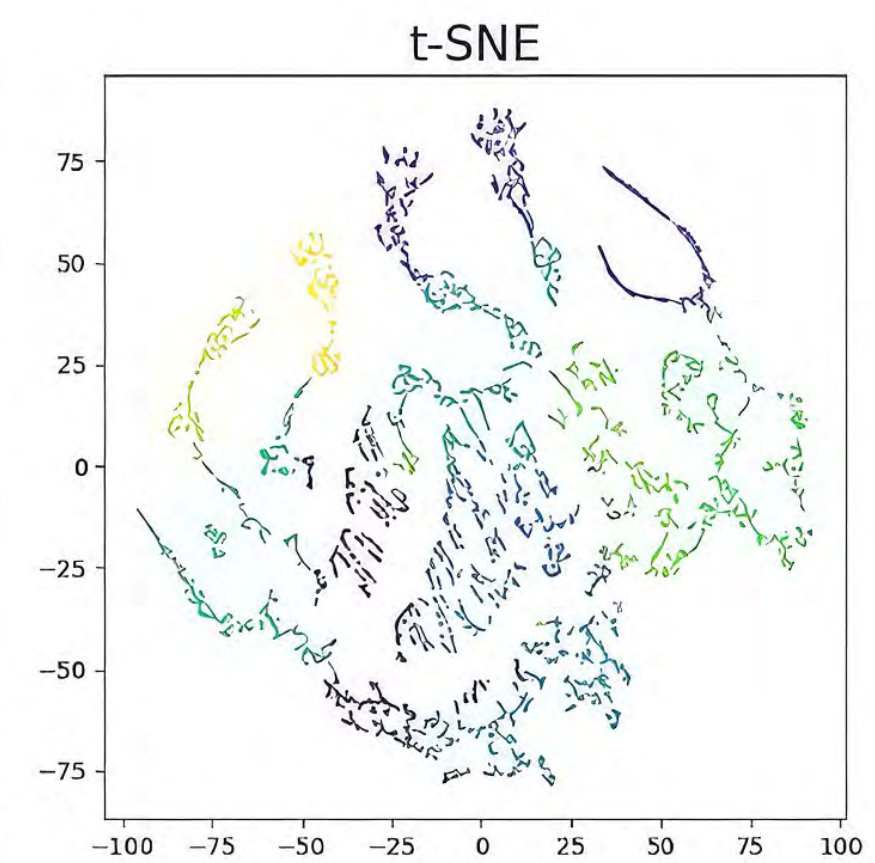
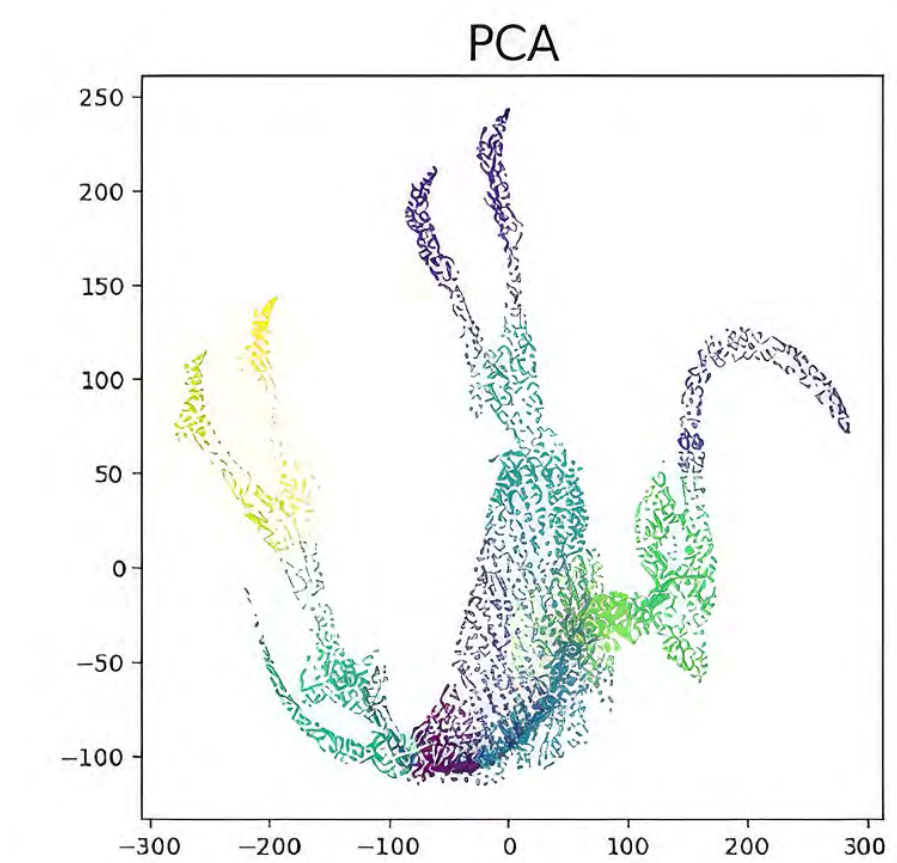
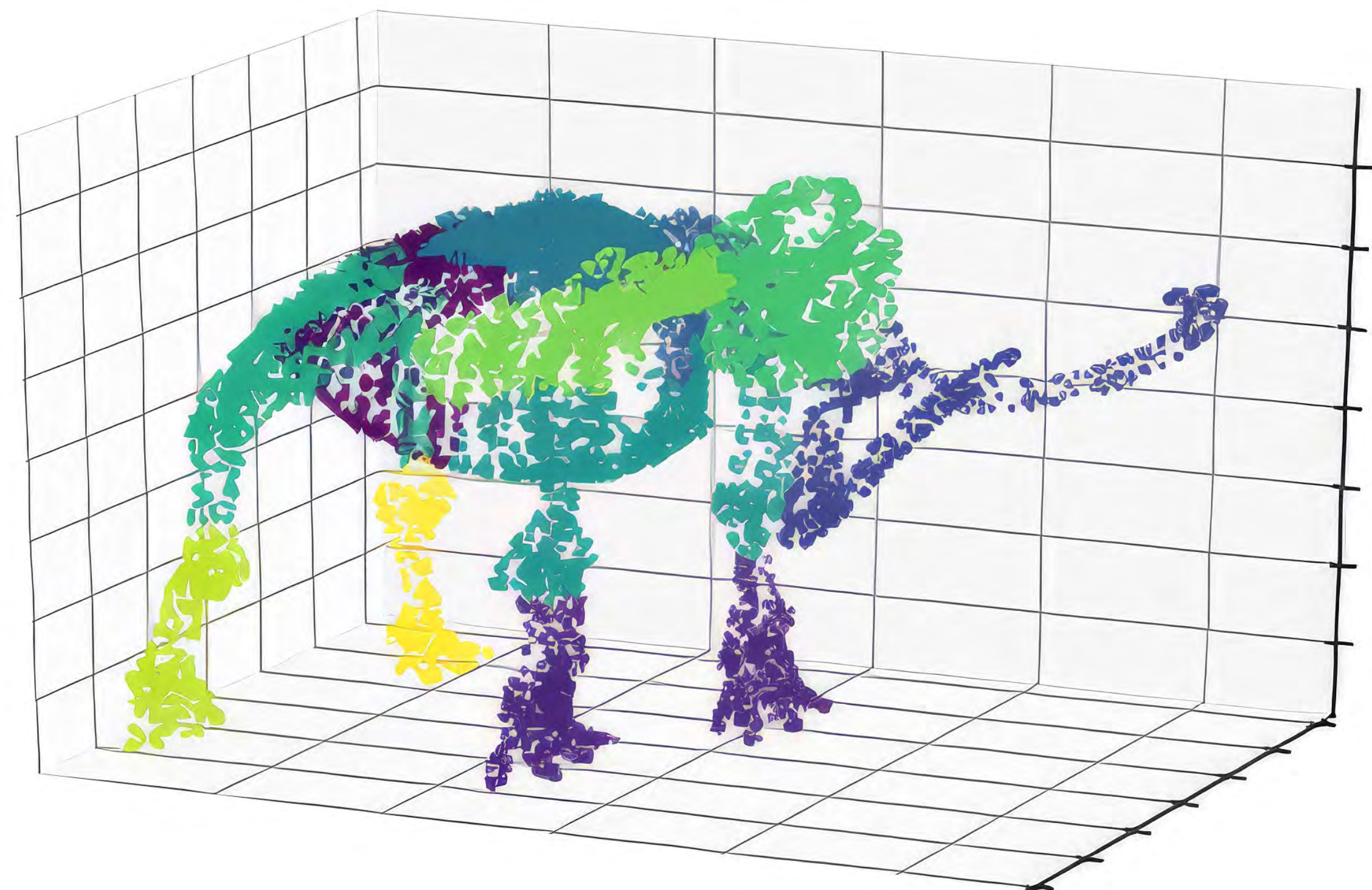
☐ $\sin(\ln(x^3)) * \cos(\ln(x^{13})) + \sin(y) * \text{random}(-.5, 2) / 3$

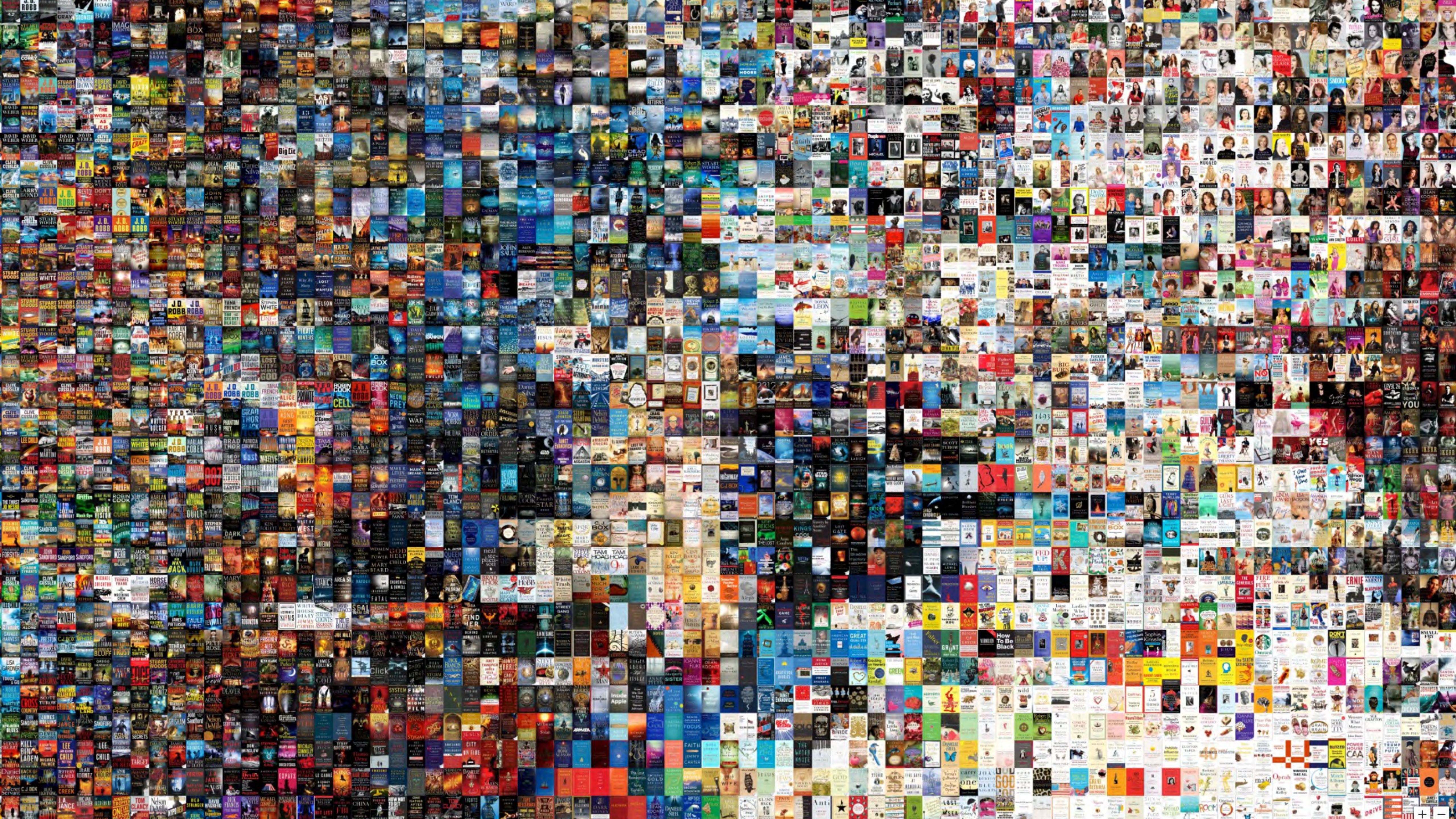
☐ $\sin(\ln(x)) + \sin(y * 2\pi) * \text{random}(-.5, 2)$

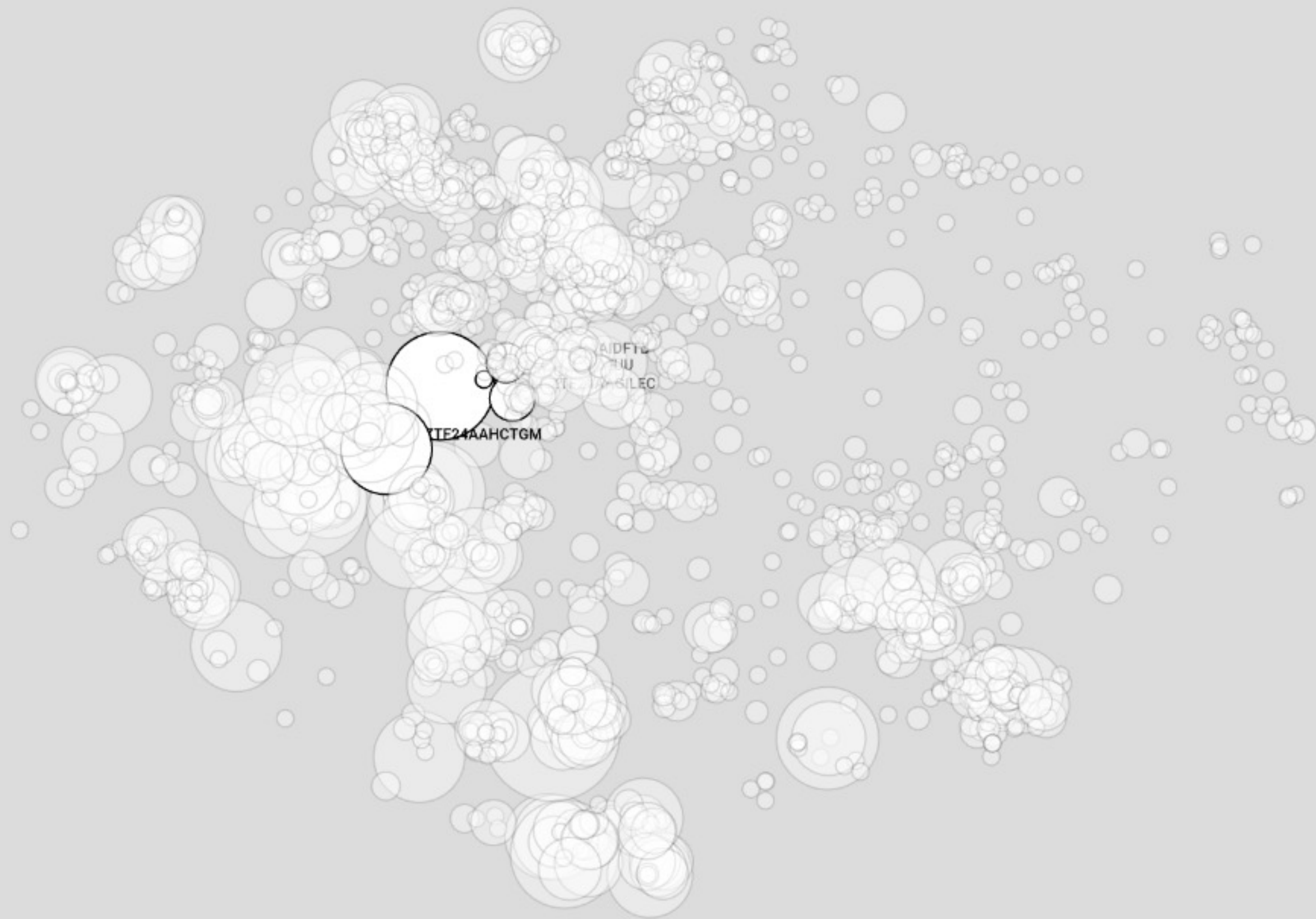
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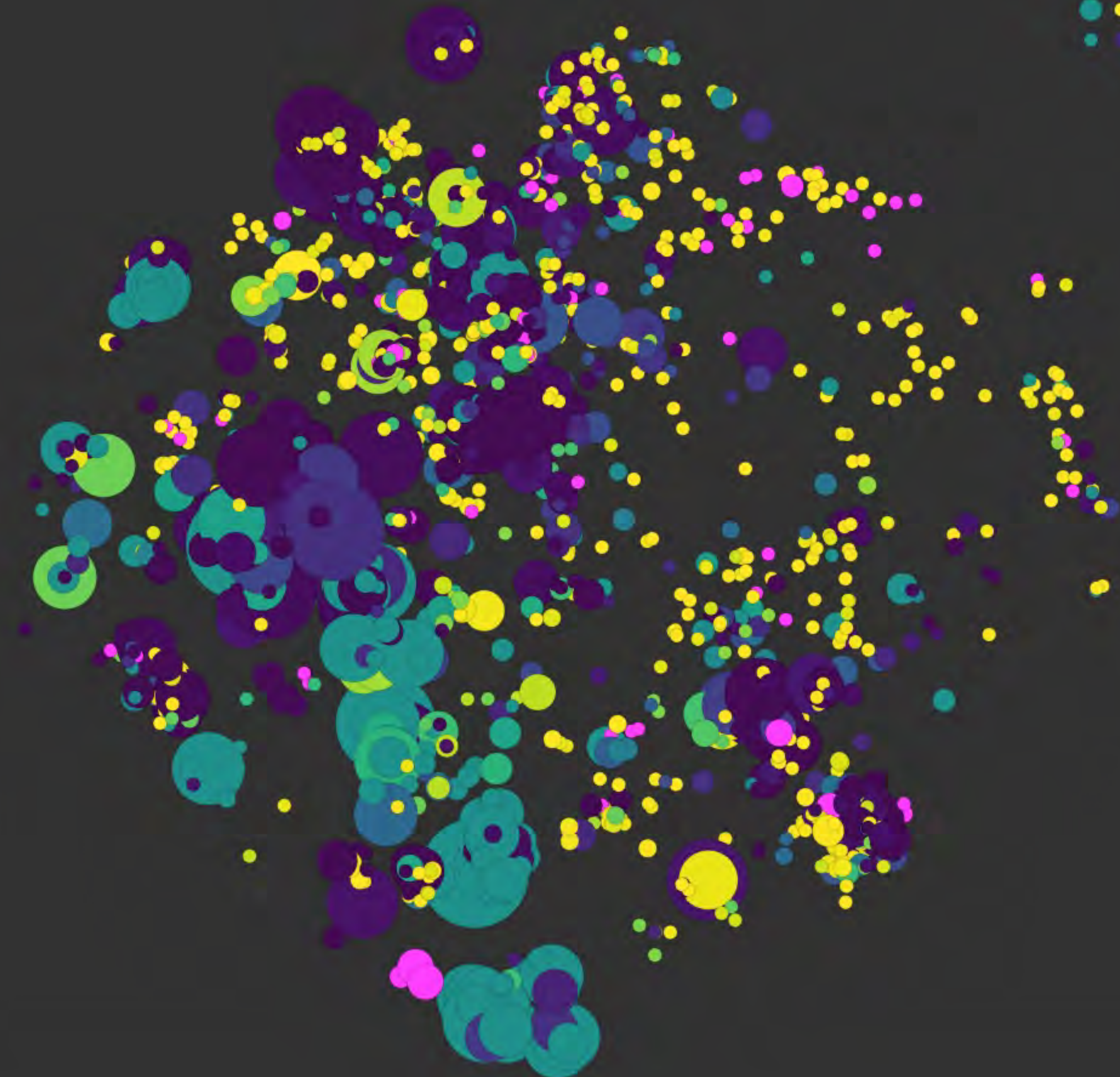
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NTSNEDOTS: 2467
NFILTERS: 40



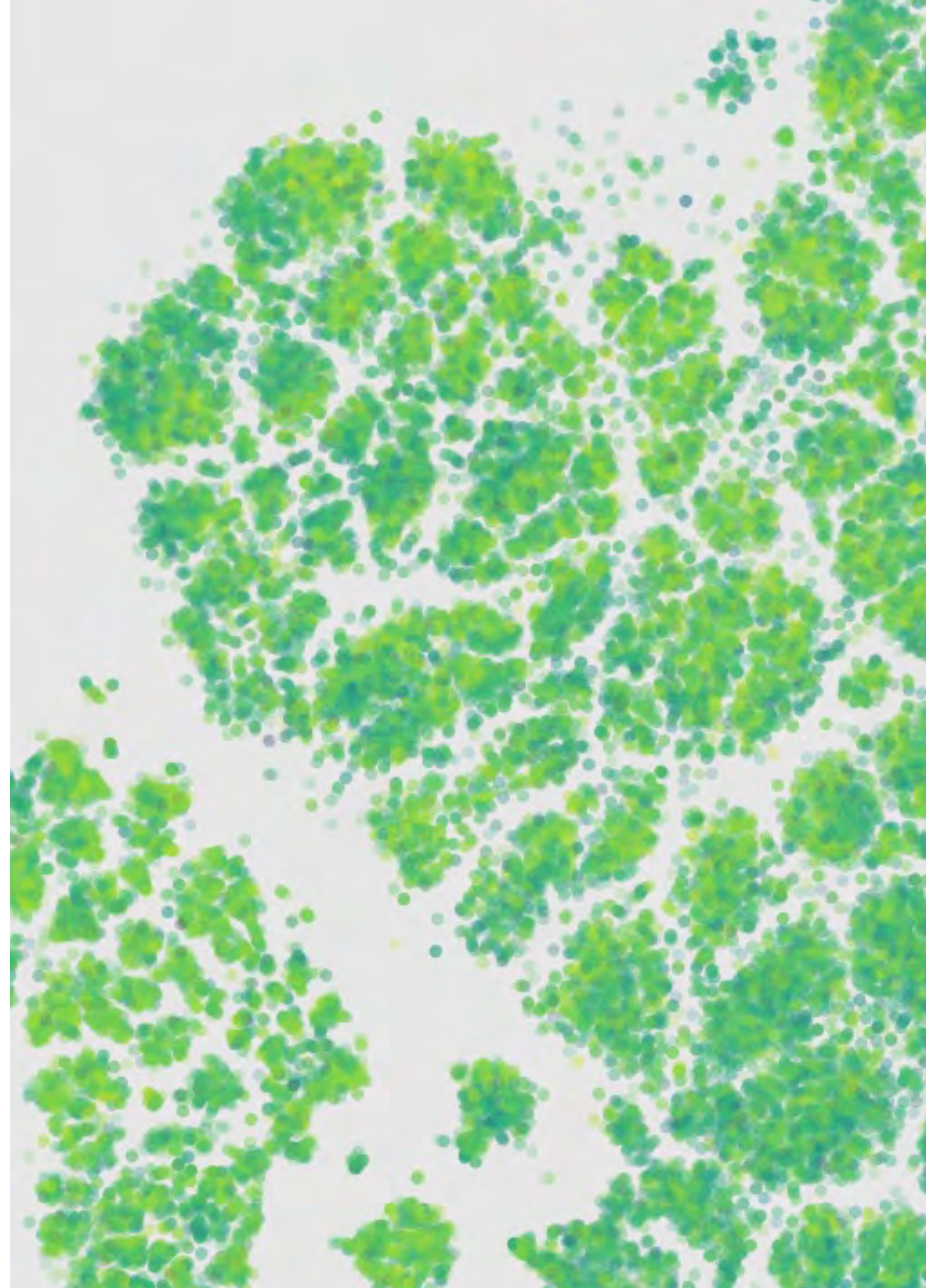
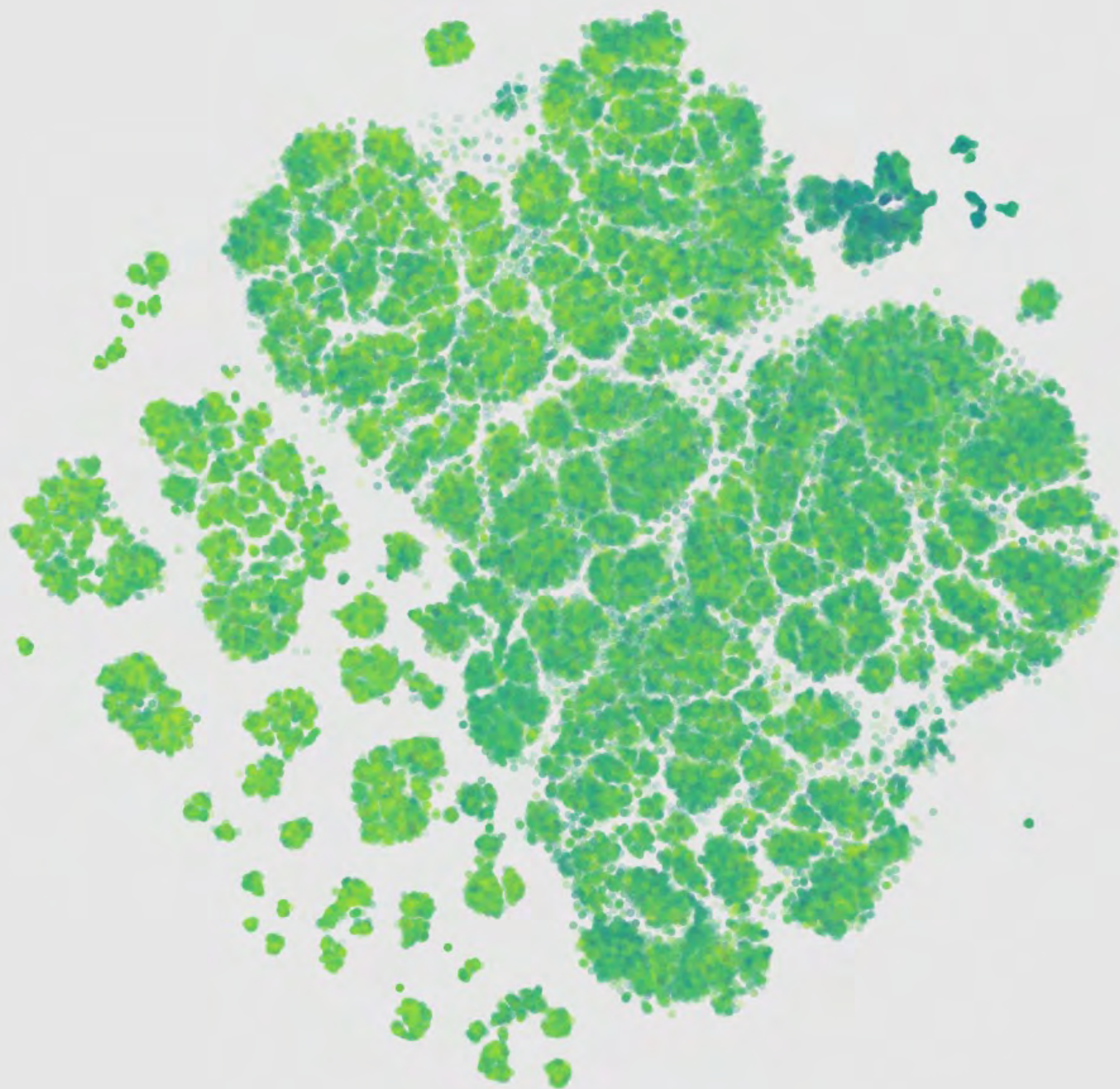
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NUMBER OF FILTERS PASSED ▾

colormap
PURPLE TO LIME ▾

fisheye
☒

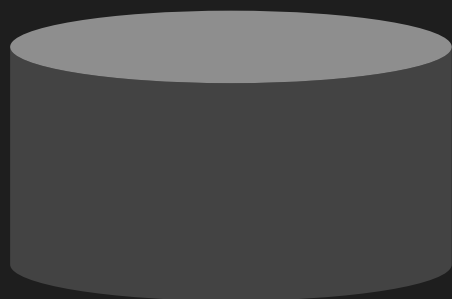
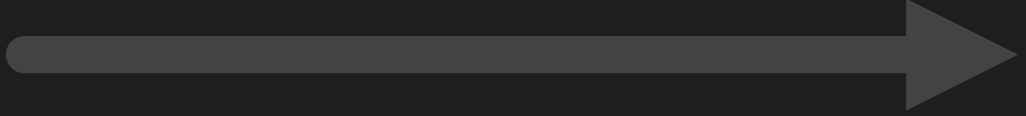


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candidate.sgscore1	candidate.ndethist	candidate.drb	classifications.acai_h	classifications.acai_v	classifications.acai_n	classifications.bts	CLUSTERS			
1	3	8	9	11	13	20	63	64	67	68
69	71	74	75	79	81	89	102	103	105	106
107	111	112	121	1159	1160	1162				
1163	1164	1168	1169	1174	1176	1178	1179	1180	1181	1182

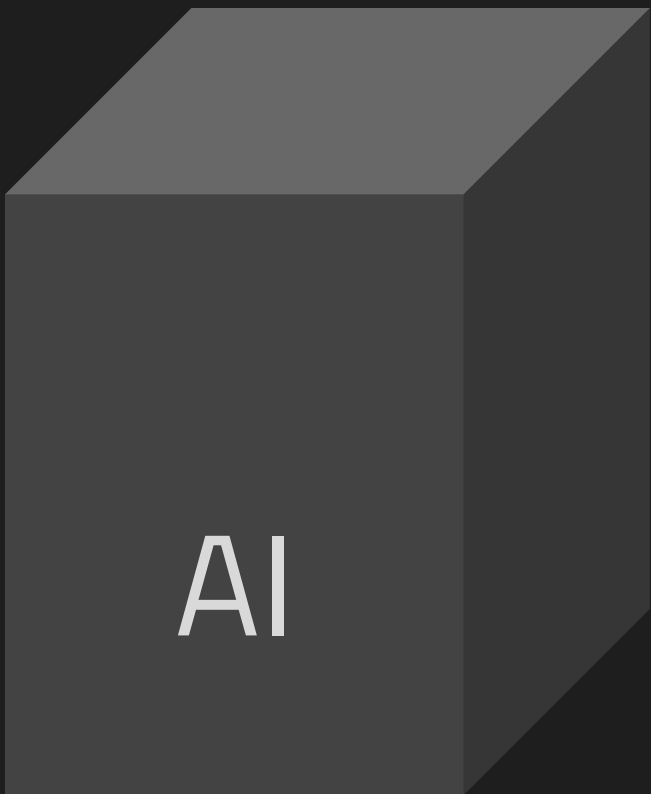
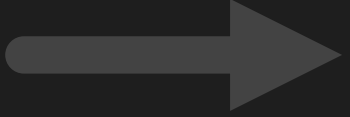




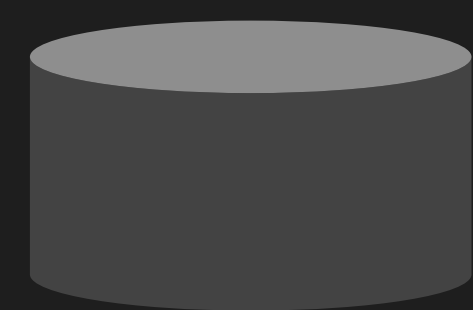
QUESTION
/GOAL



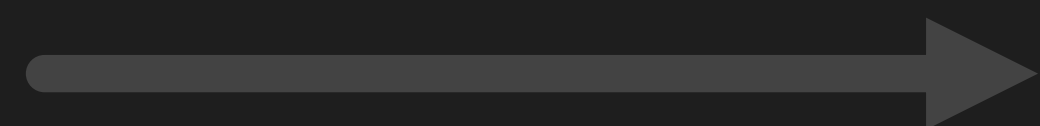
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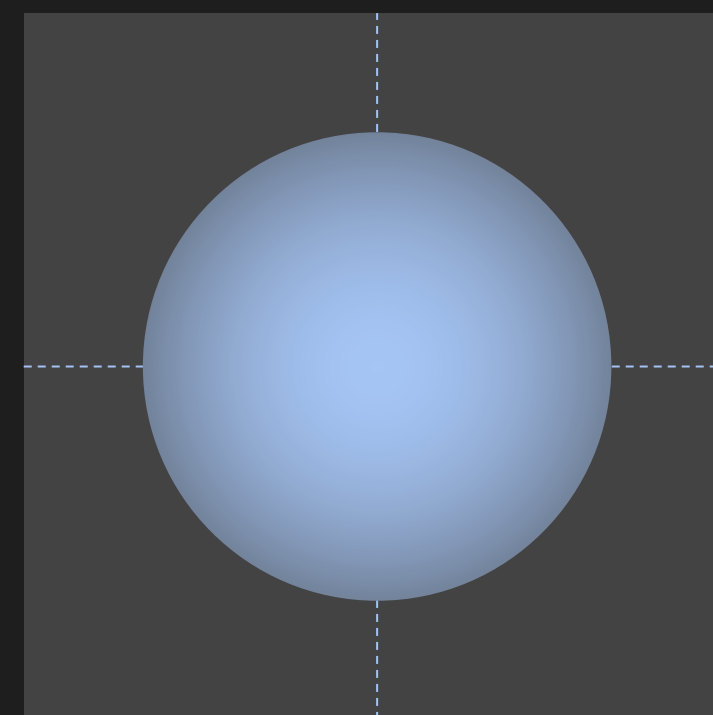
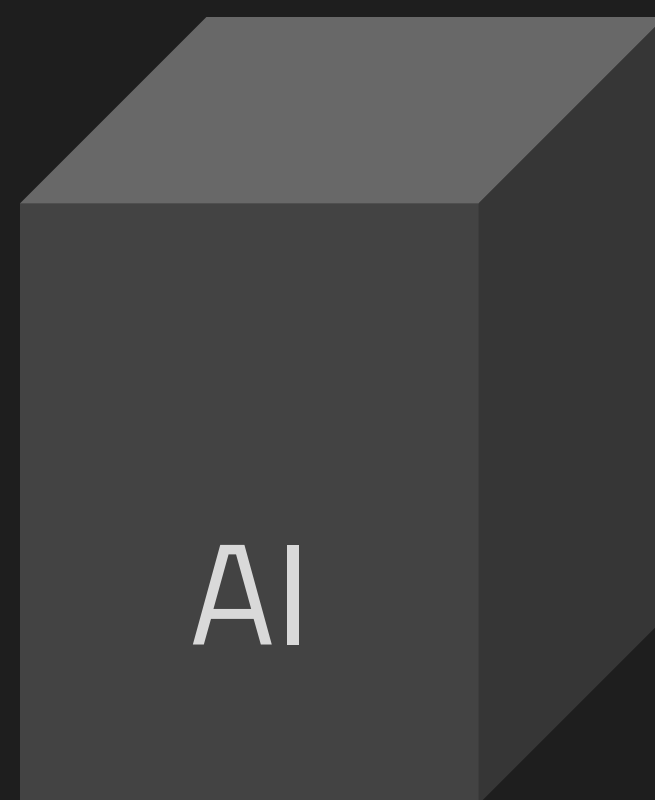
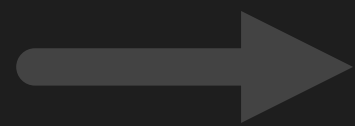
- Solution 01
- Solution 02
 - Alternative 02.1
 - Alternative 02.2
- Solution 03
- Further Explorations

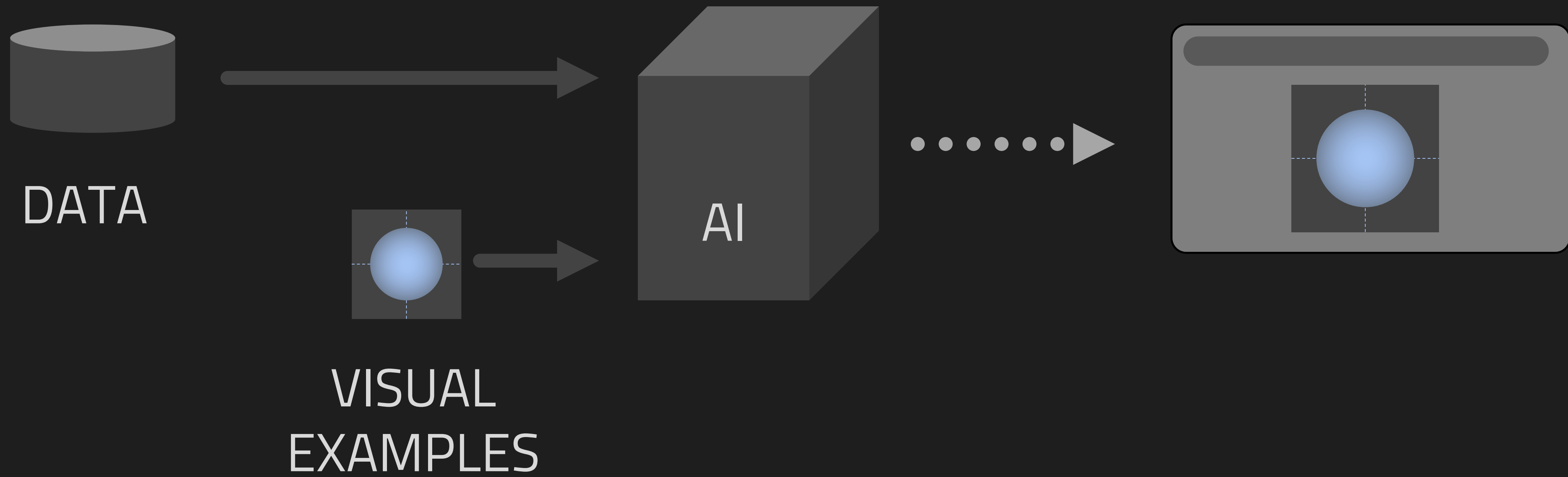


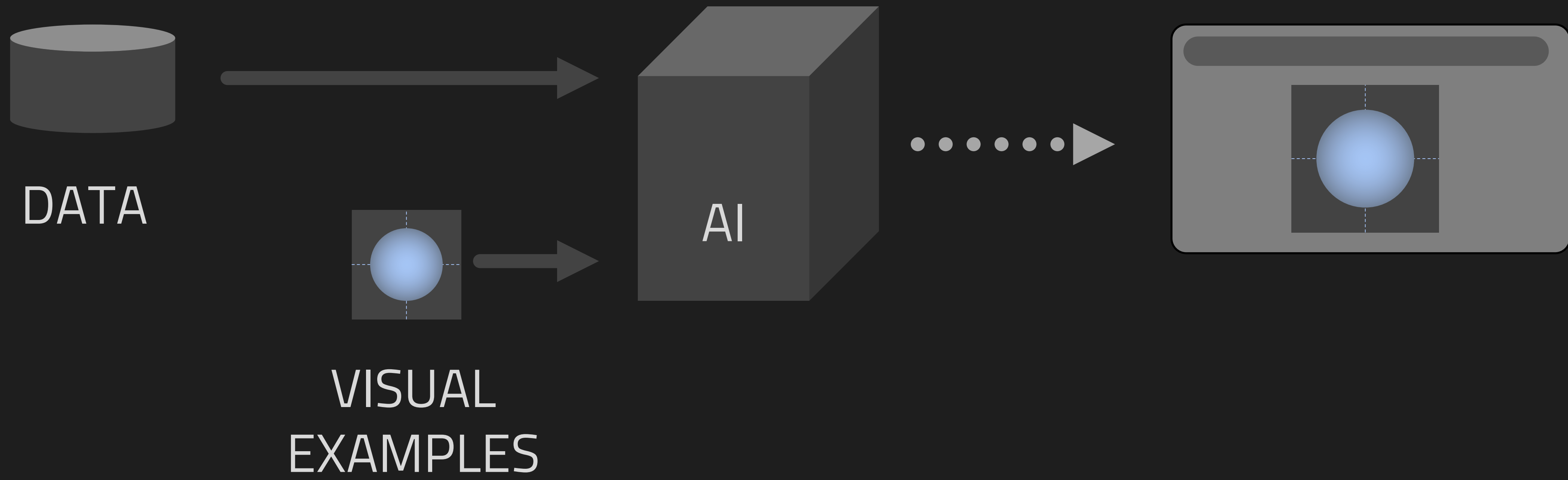
DATA



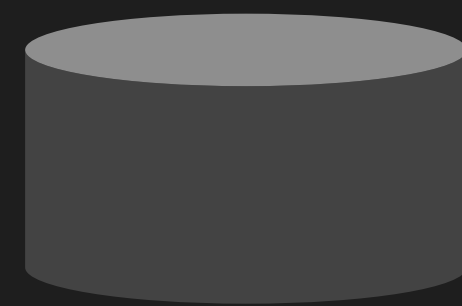
QUESTION
/GOAL



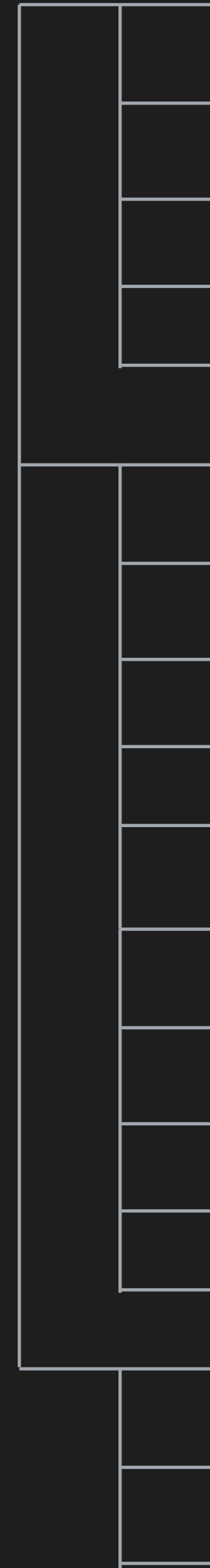
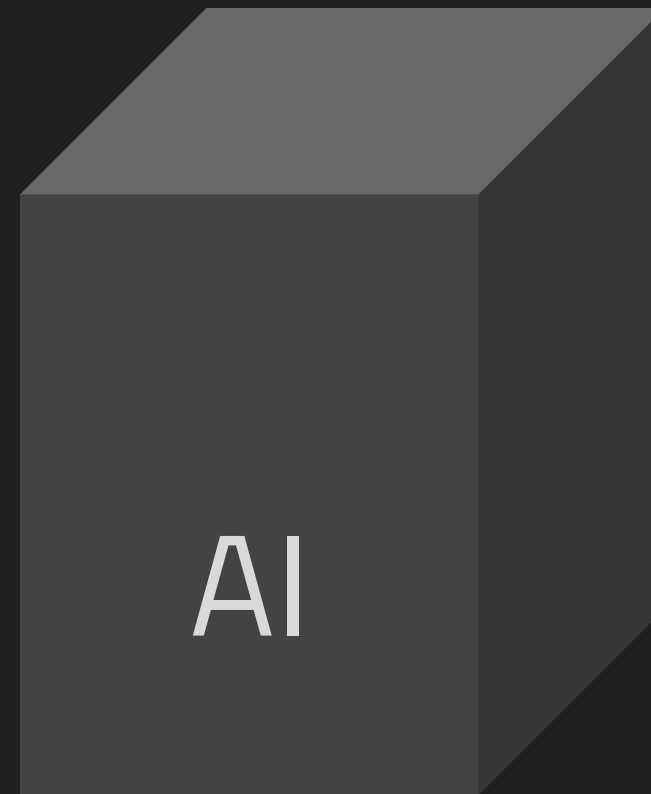
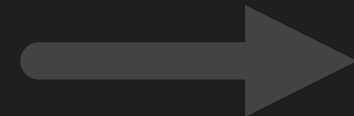
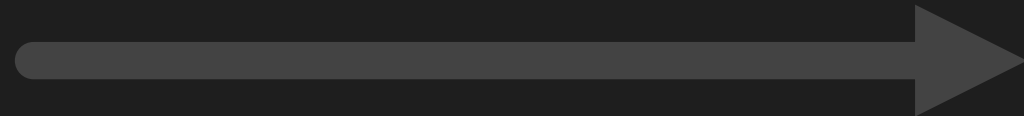




TARGET
INFRASTRUCTURE
PLAN



DATA



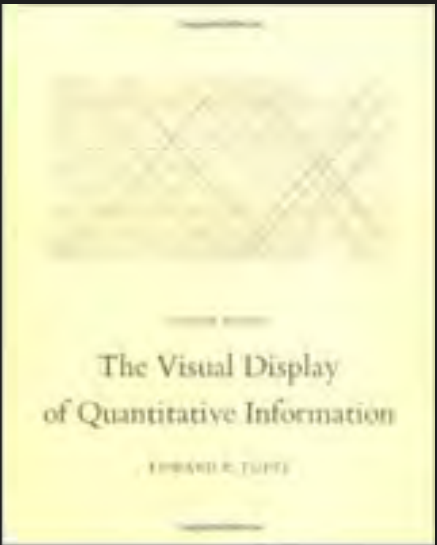
```
class DataStore {  
  constructor() { }  
  syncData() {}  
  manageData() {}  
}
```

```
class UIMananager {  
  constructor() { }  
  registerAction() {}  
  propagateEvent() {}  
}
```

```
class DataManager {  
  constructor() { }  
  loadData() {}  
  summarizeData() {}  
}
```

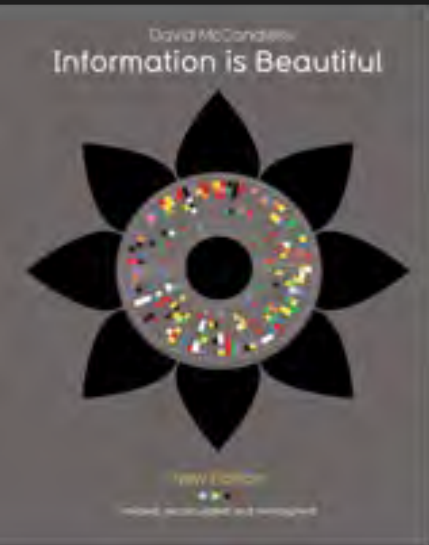
```
class MainCanvas {  
  constructor() { }  
  activateData() {}  
  ractToEvent() {}  
}
```


Visualizing Data
Getting Started with p5.js
Ben Fry



The Visual Display of Quantitative Information
Envisioning Information
Edward Tufte

The Data Loom
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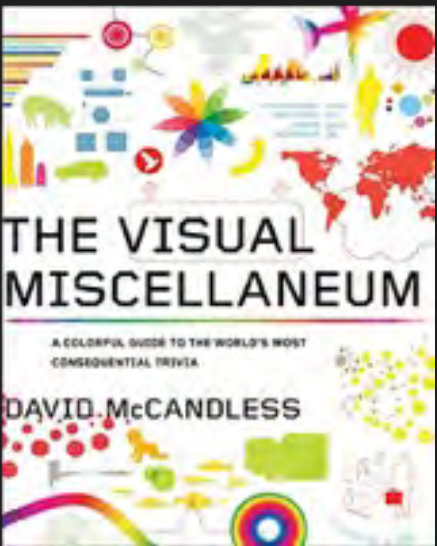


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