

Critical Reflections on Visualization Authoring Systems

Lyra



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Which Visualization Authoring Tool?

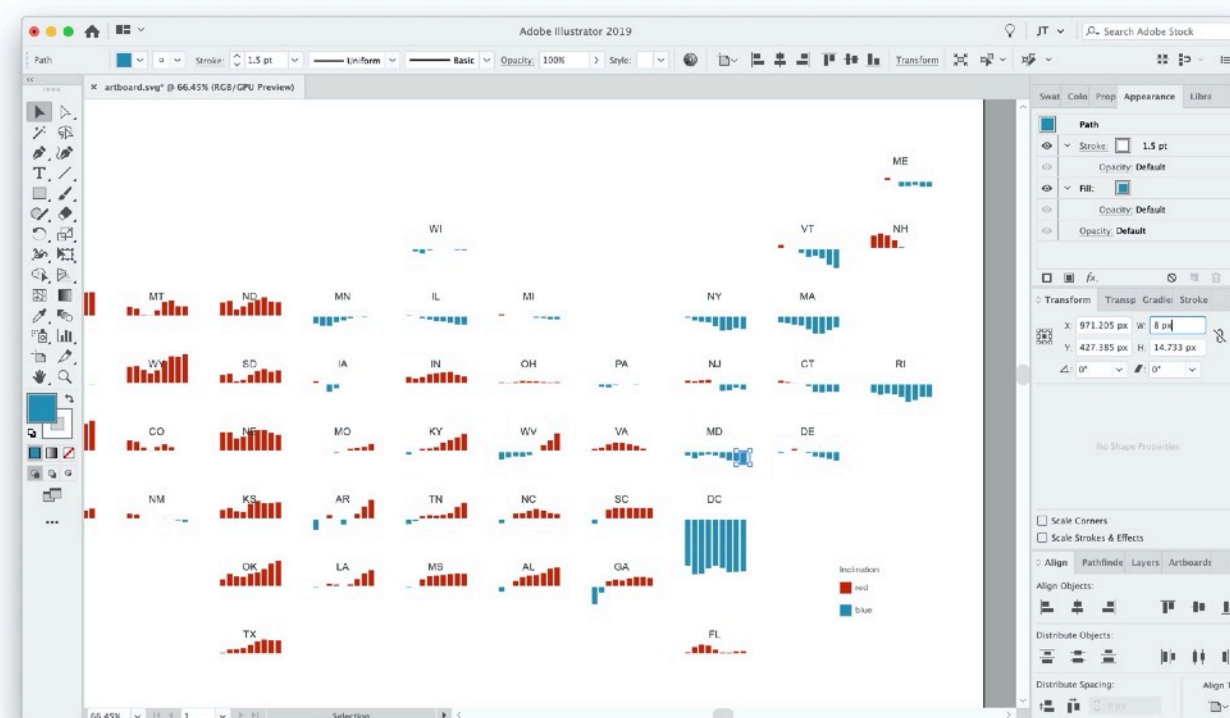
Imperative & Declarative Programming

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108 var minorTicks = [];  
109 for (var y = 1981; y <= 2011; y++) { (y < 2000) ? minorTicks.push(0.5 * Math.PI) :  
110  
111 var width = d3.svg.axis().scale(x).  
112 <tickLabels>{orient: 'top'};  
113  
114 var categoryMap = { 'chemistry': 'chemistry', 'physics': 'physics', 'literature': 'literature', 'medicine': 'medicine', 'peace': 'peace' };  
115  
116 var y = d3.scale.linear()  
117 .domain([0, 40])  
118 .range([0, 40]);  
119  
120 var bar = d3.scale.linear()  
121 .domain([0, 20])  
122 .range([0, 40]);  
123  
124 var dept = d3.scale.ordinal()  
125 .domain(['phd', 'masters', 'bachelors', 'none'])  
126 .rangeBands([0, 40], 0.1, 0.1);  
127  
128 var dept = d3.scale.linear()  
129 .domain([0, 20])  
130 .range([0, 40]);  
131  
132 var deptAxis = d3.svg.axis().scale(dept).  
133 <tickLabels>{orient: 'top'};  
134  
135 var width = d3.svg.axis().scale(x).  
136 <tickLabels>{orient: 'left'};  
137  
138 var line = d3.svg.line()  
139 .x(function(d) { return d.year; })  
140 .y(function(d) { return d.value; });  
141  
142 var app = { year: 2000, value: 10 };  
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Programming

Sketching & Vector Graphic Design Tools



Drawing

Which Visualization Authoring Tool?

Imperative & Declarative Programming

Interactive Visualization Authoring Tools

Sketching & Vector Graphic Design Tools

Programming



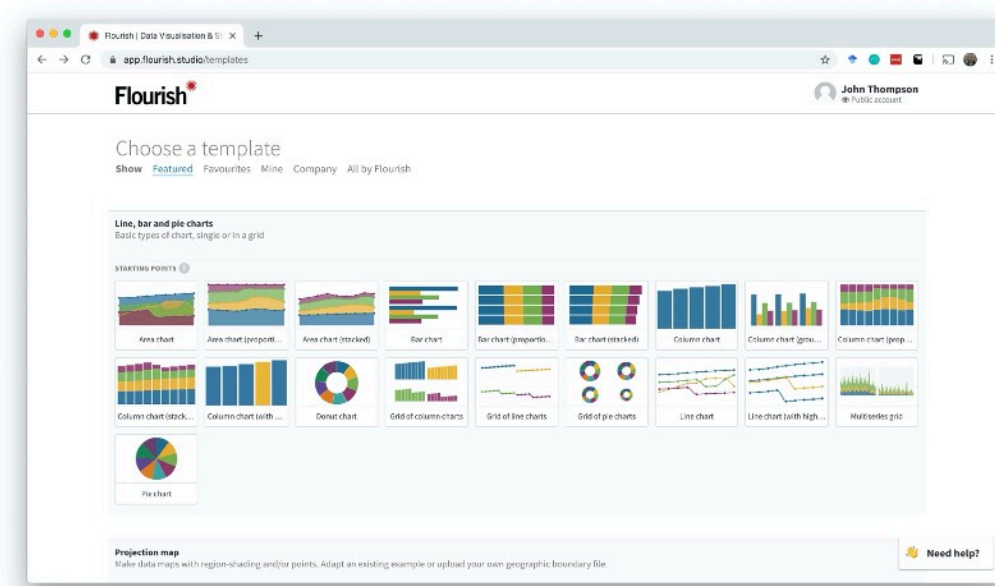
Drawing

Which Visualization Authoring Tool?

Imperative & Declarative Programming

Interactive Visualization Authoring Tools

Template Editors



Sketching & Vector Graphic Design Tools

Programming

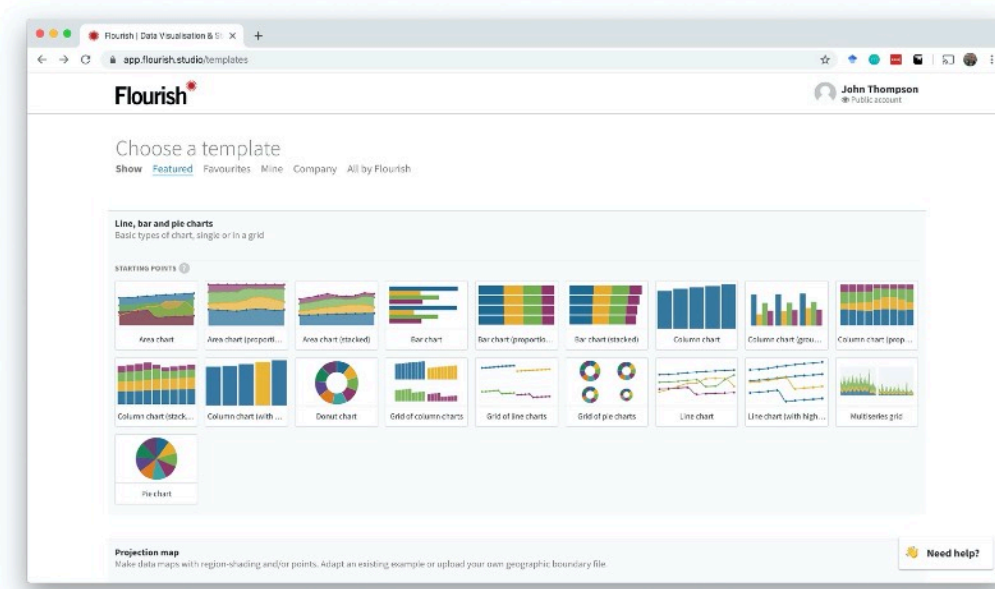
Drawing

Which Visualization Authoring Tool?

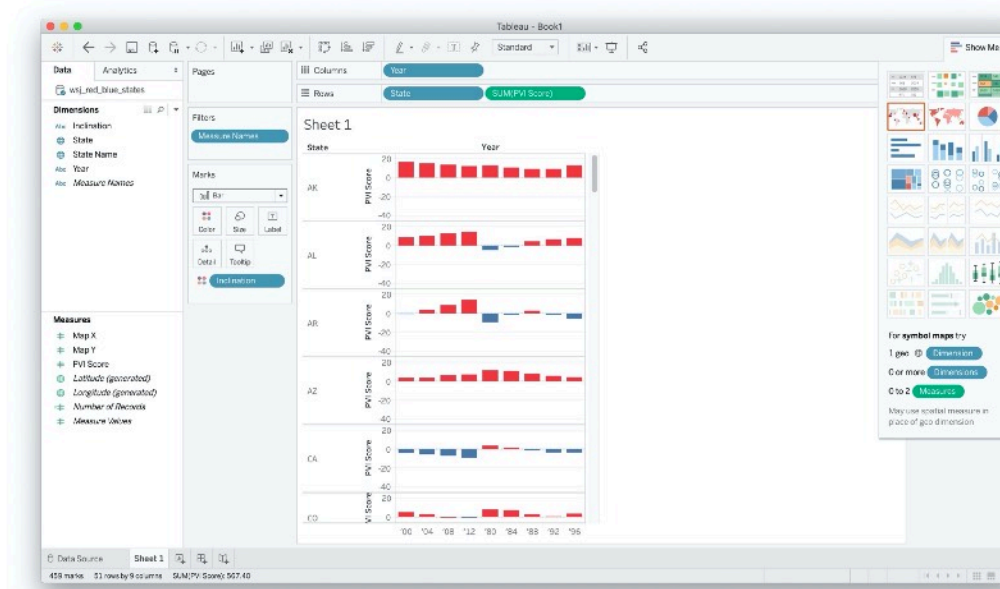
Imperative & Declarative Programming

Interactive Visualization Authoring Tools

Template Editors



Shelf Construction



Sketching & Vector Graphic Design Tools

Programming



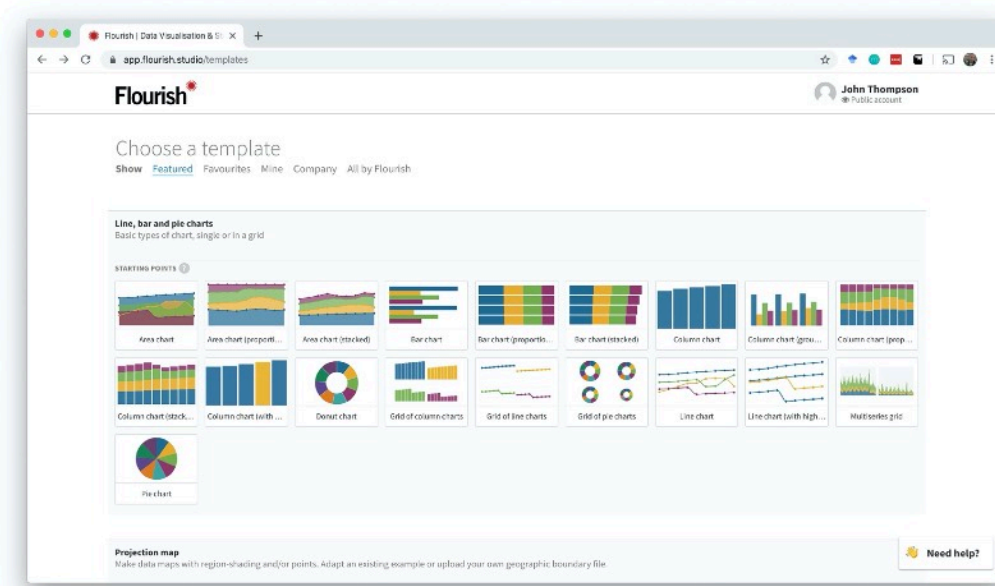
Drawing

Which Visualization Authoring Tool?

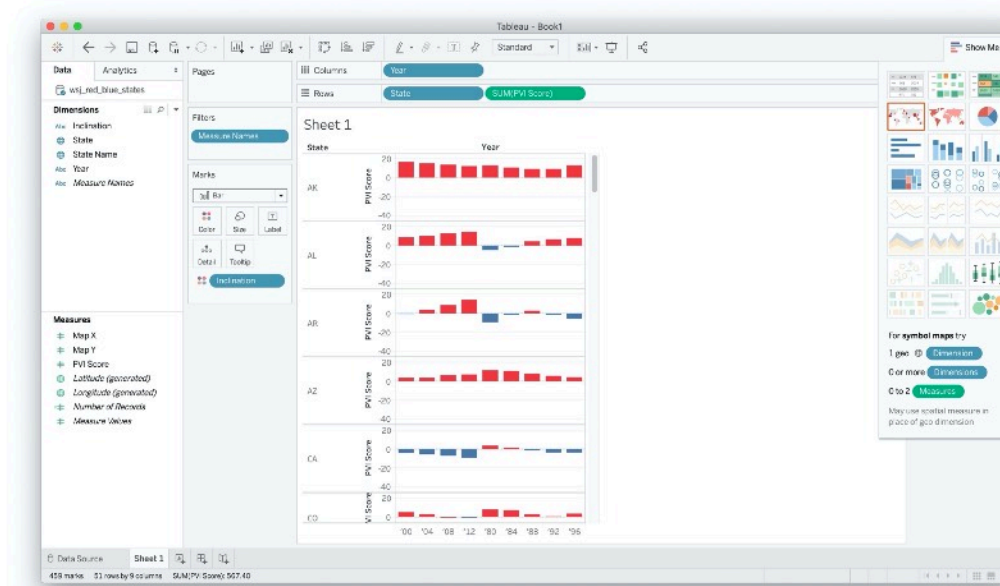
Imperative & Declarative Programming

Interactive Visualization Authoring Tools

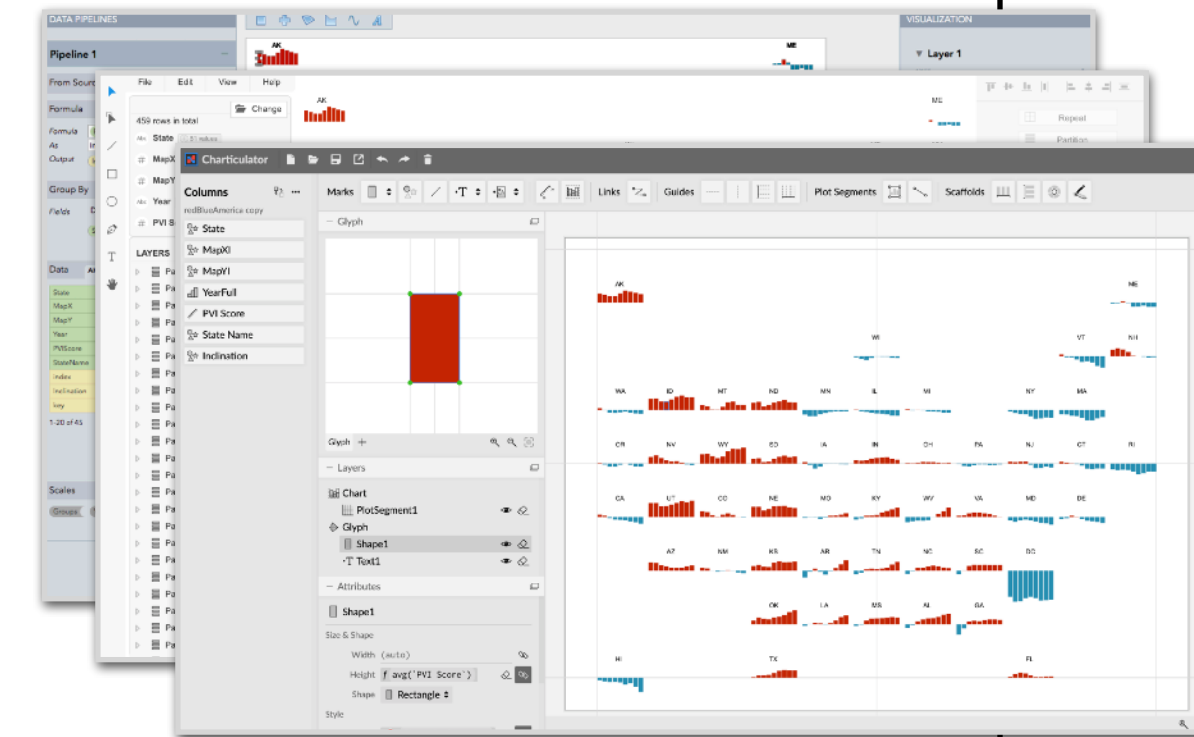
Template Editors



Shelf Construction



Visual Builders



Programming

Drawing

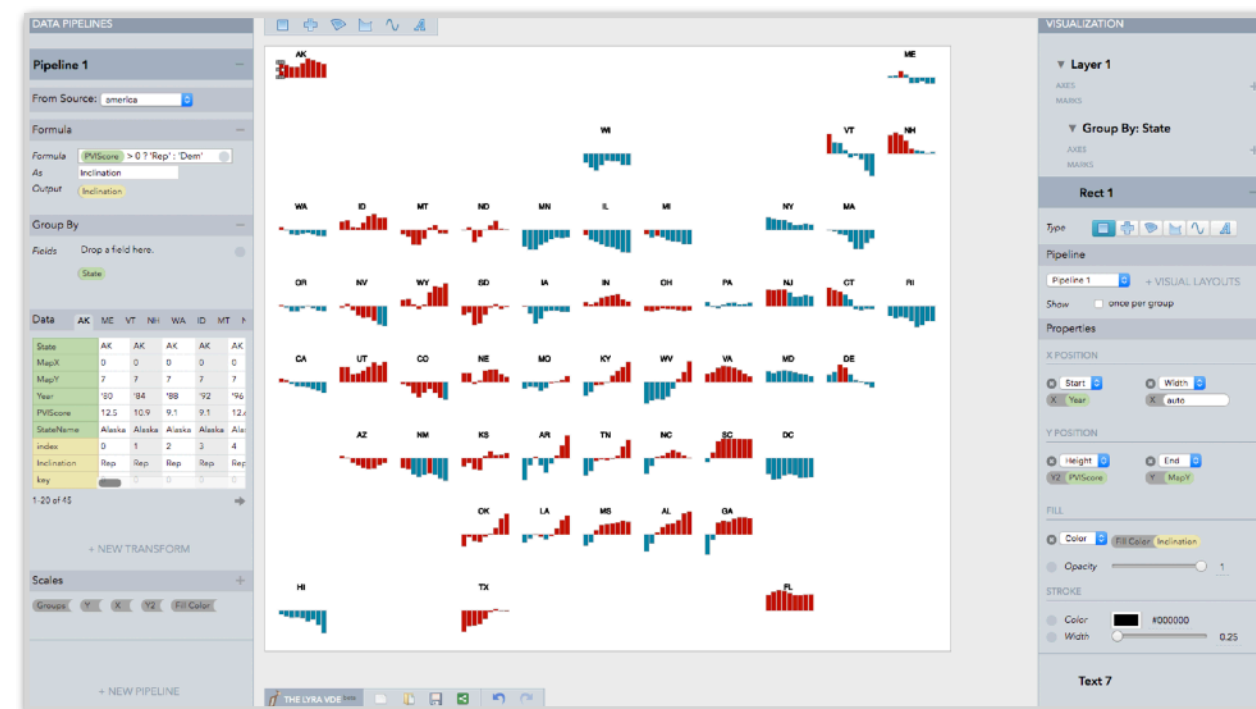
Sketching & Vector Graphic Design Tools

“Can the tool build that visualization?” —→ Expressivity

“How easy is the system to learn?” —→ Learnability

Visual Builders

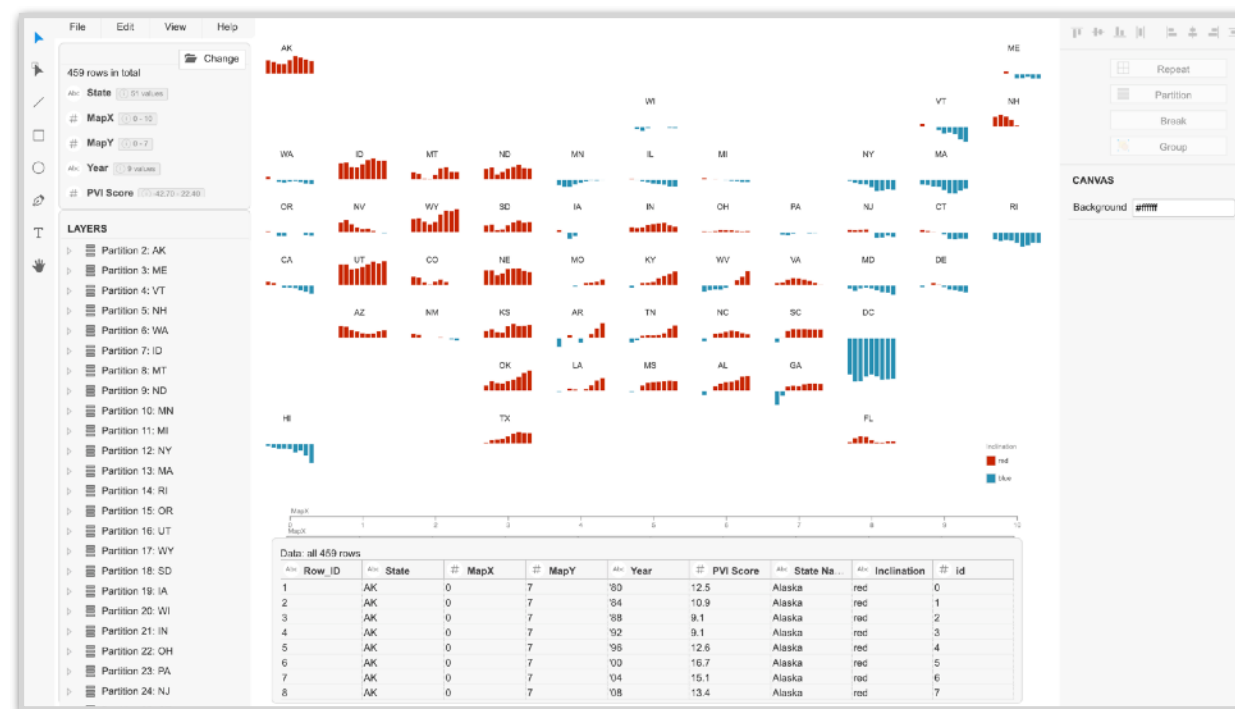
Expressive authoring of visualizations without textual programming



Lyra

Arvind Satyanarayan, Jeffrey Heer

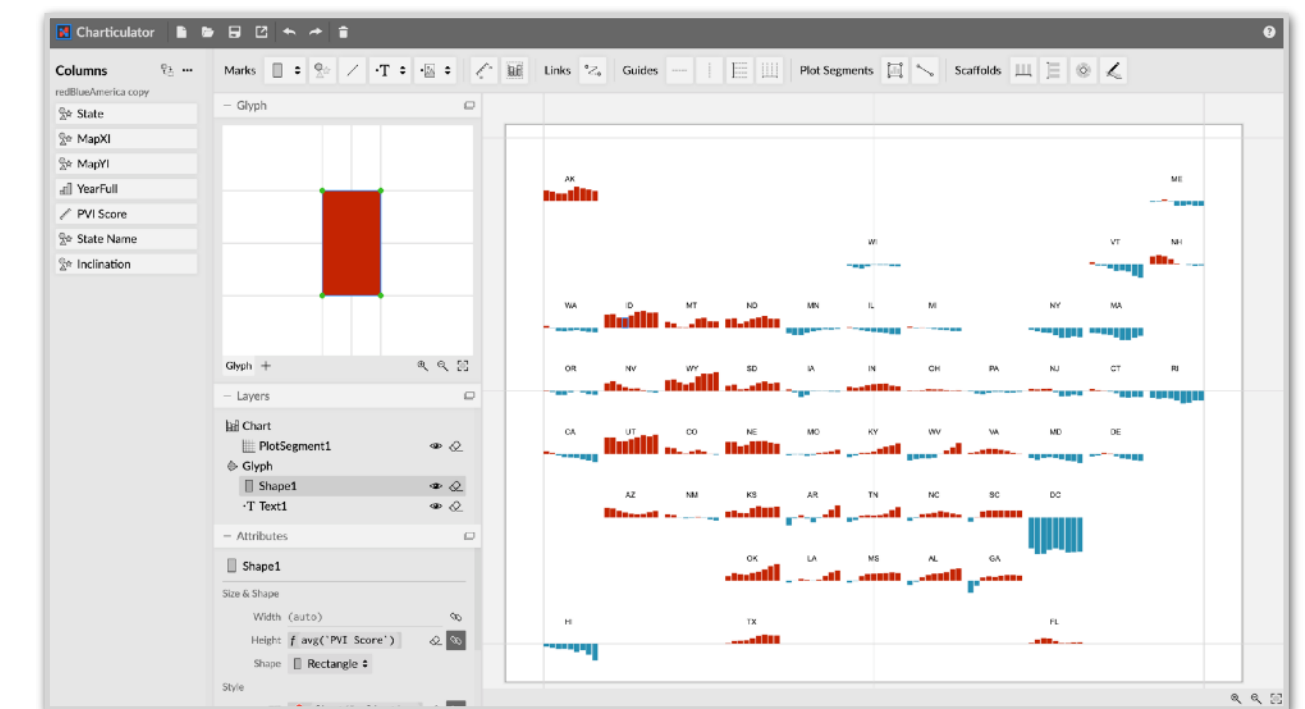
EuroVis 2014



Data Illustrator

Zhicheng Liu, John Thompson, Alan Wilson, Mira Dontcheva, James Delorey, Sam Grigg, Bernard Kerr, John Stasko

CHI 2018



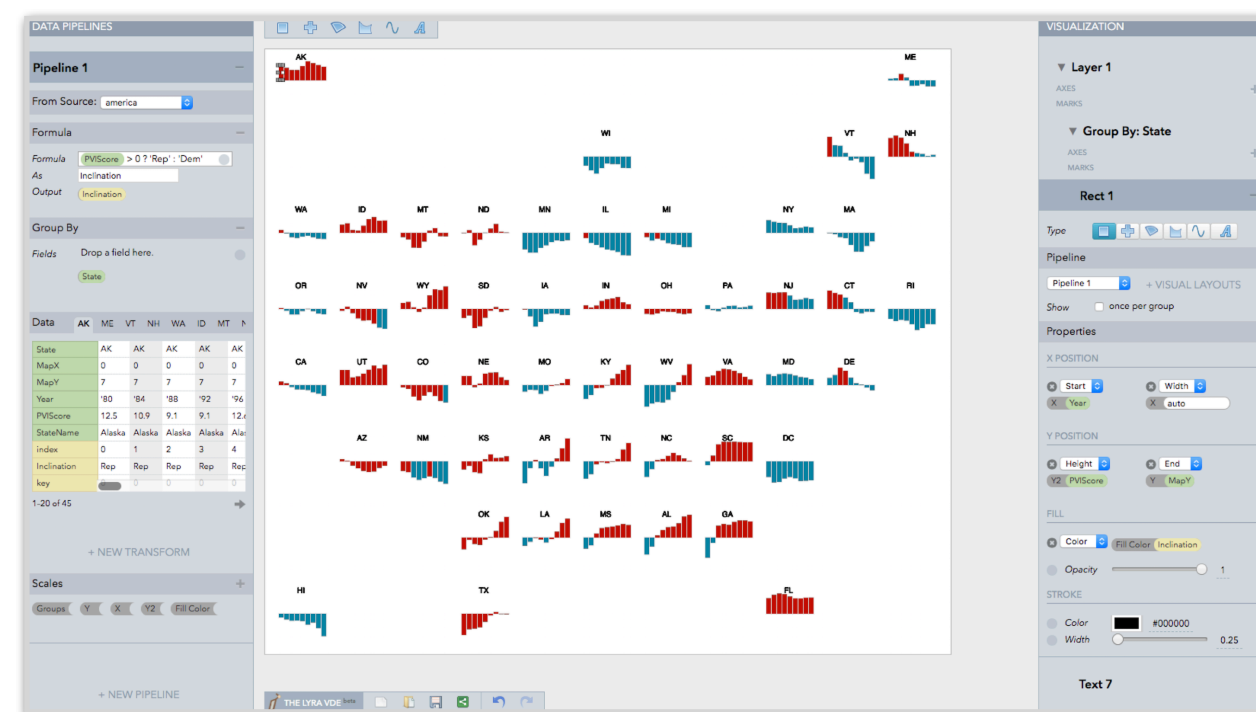
Charticulator

Donghao Ren, Bonghsin Lee, Matthew Brehmer

InfoVis 2018

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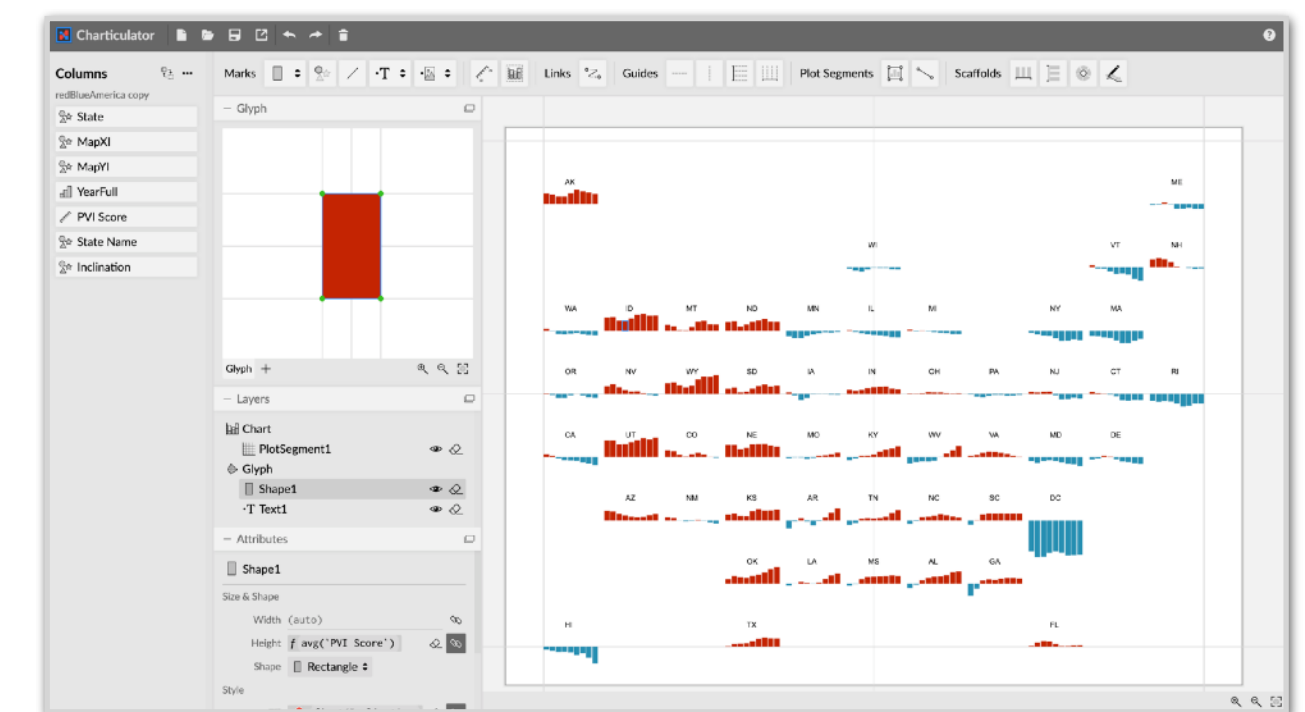
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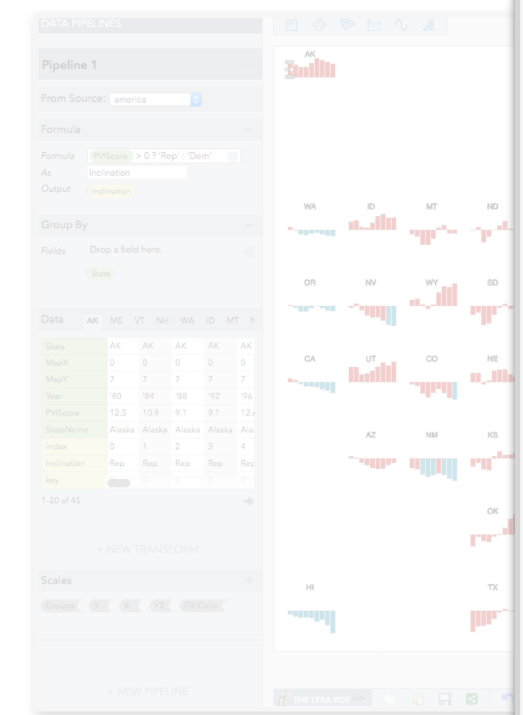
Charticulator

Donghao Ren, Bonghsin Lee, Matthew Brehmer

InfoVis 2018

Visual Builders

Express



Lyra

Arvind Satyana

EuroVis 2014

459 rows in total

State 51 values

MapX 0-10

MapY 0-7

Year 9 values

PVI Score -42.70 - 22.40

LAYERS

- Partition 2: AK
- Partition 3: ME
- Partition 4: VT
- Partition 5: NH
- Partition 6: WA
- Partition 7: ID
- Partition 8: MT
- Partition 9: ND
- Partition 10: MN
- Partition 11: MI
- Partition 12: NY
- Partition 13: MA
- Partition 14: RI
- Partition 15: OR
- Partition 16: UT
- Partition 17: WY
- Partition 18: SD
- Partition 19: IA
- Partition 20: WI
- Partition 21: IN
- Partition 22: OH
- Partition 23: PA
- Partition 24: NJ

Background #ffffff

Repeat

Partition

Break

Group

Canvas

Background #ffffff

Inclination

- red
- blue

Data: all 459 rows

Row_ID	State	MapX	MapY	Year	PVI Score	State Na...	Inclination	id
1	AK	0	7	'80	12.5	Alaska	red	0
2	AK	0	7	'84	10.9	Alaska	red	1
3	AK	0	7	'88	9.1	Alaska	red	2
4	AK	0	7	'92	9.1	Alaska	red	3
5	AK	0	7	'96	12.6	Alaska	red	4
6	AK	0	7	'00	16.7	Alaska	red	5
7	AK	0	7	'04	15.1	Alaska	red	6
8	AK	0	7	'08	13.4	Alaska	red	7



Lee, Matthew

Wilson, Mira Dontcheva, James Delorey,
Sam Grigg, Bernard Kerr, John Stasko

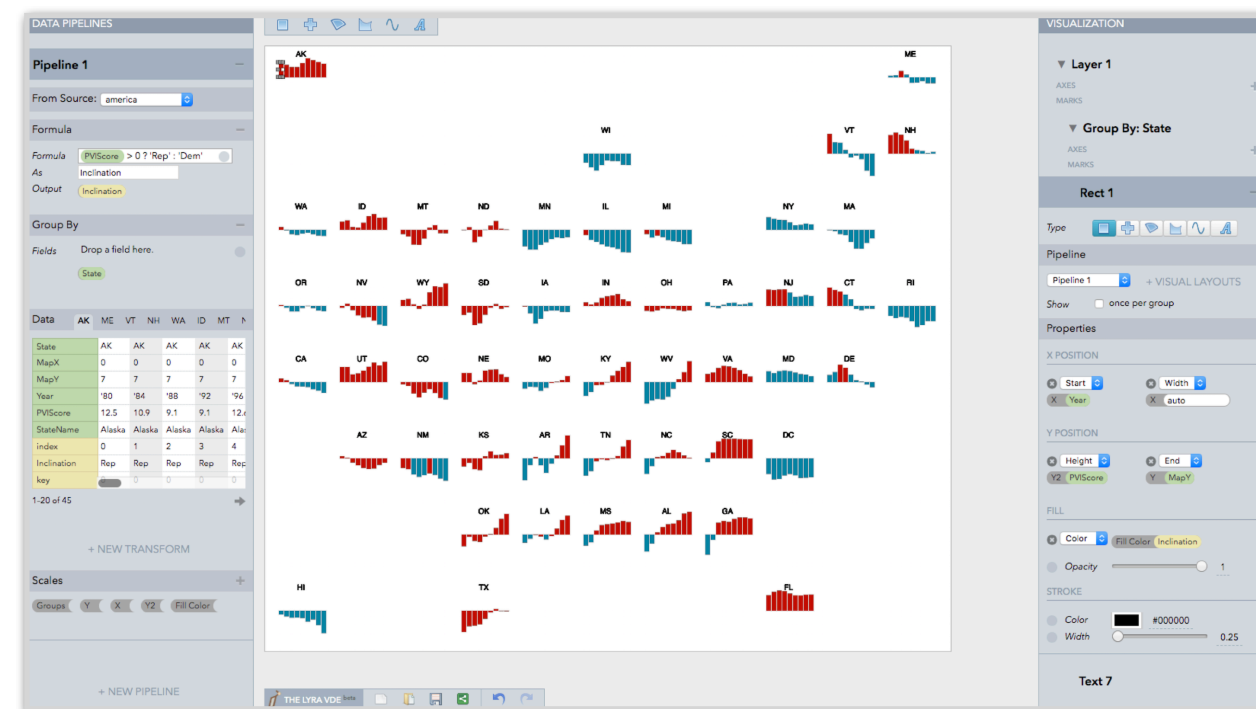
CHI 2018

Brehmer

InfoVis 2018

Visual Builders

Expressive authoring of visualizations without textual programming



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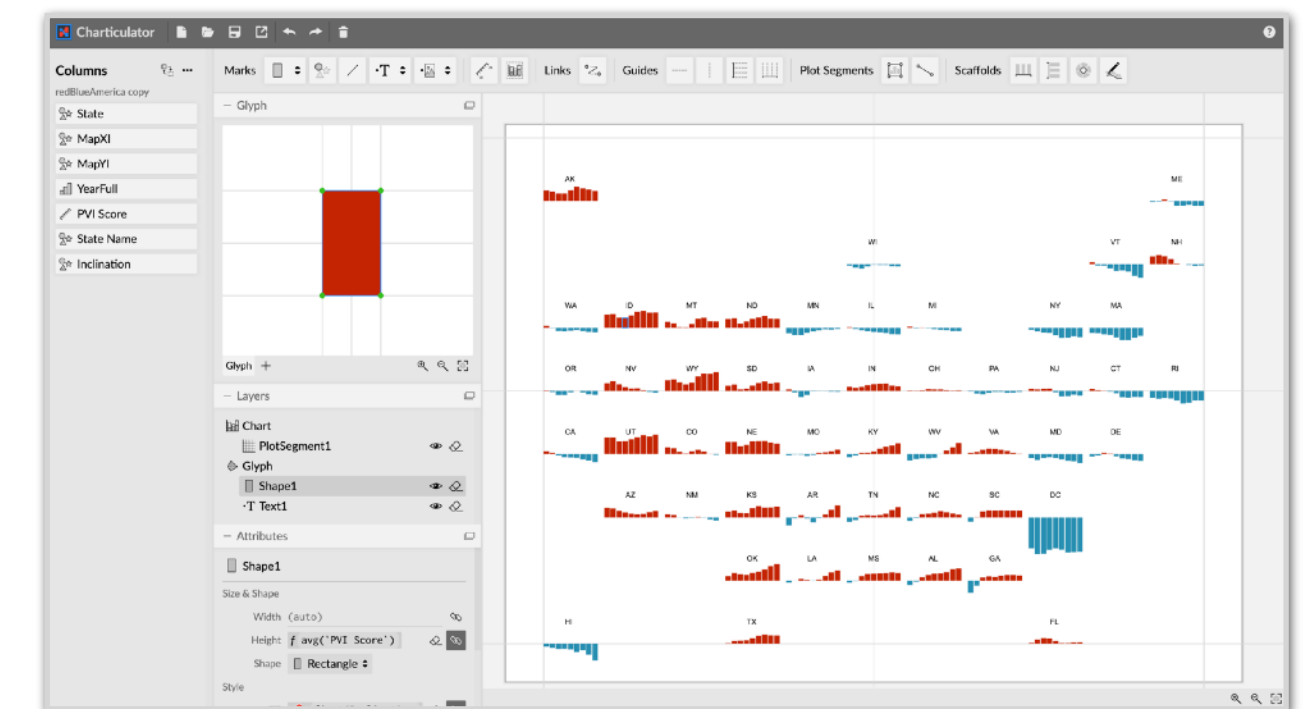
EuroVis 2014



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CHI 2018



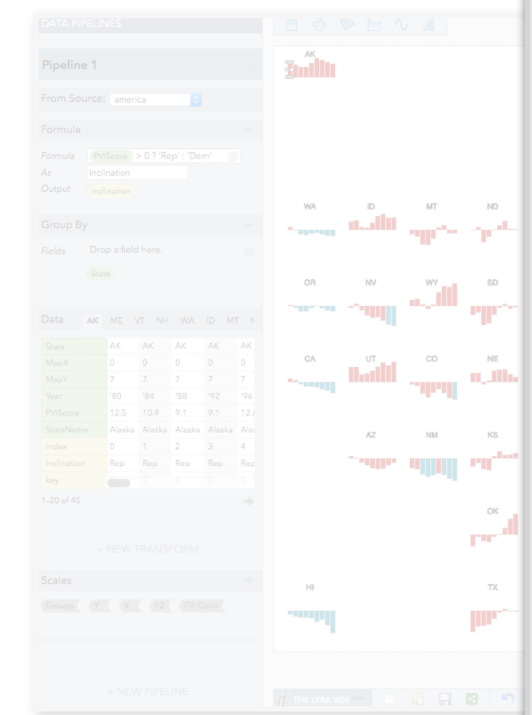
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Visual Builders

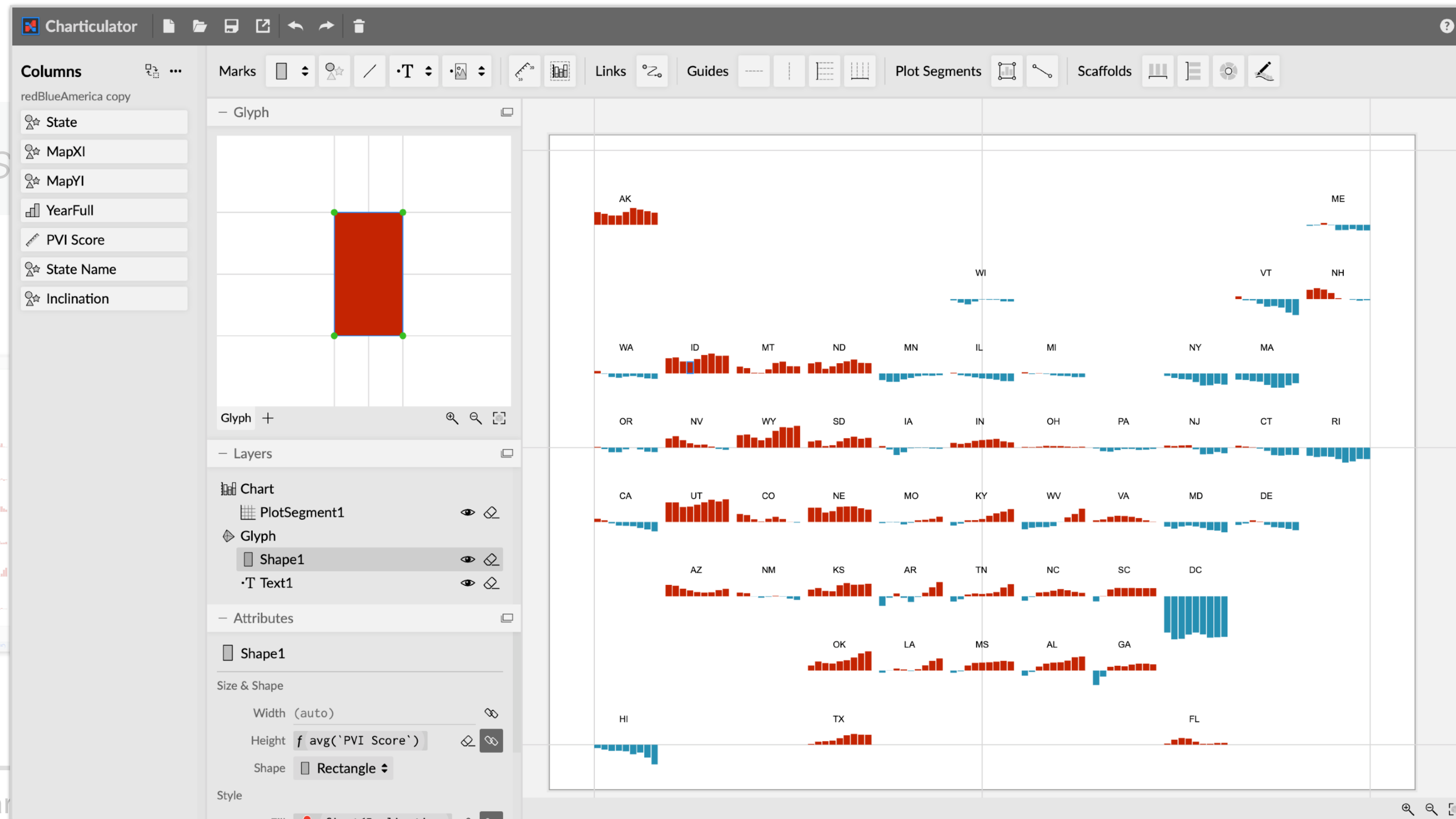
Express



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Arvind Satyanar

EuroVis 2014



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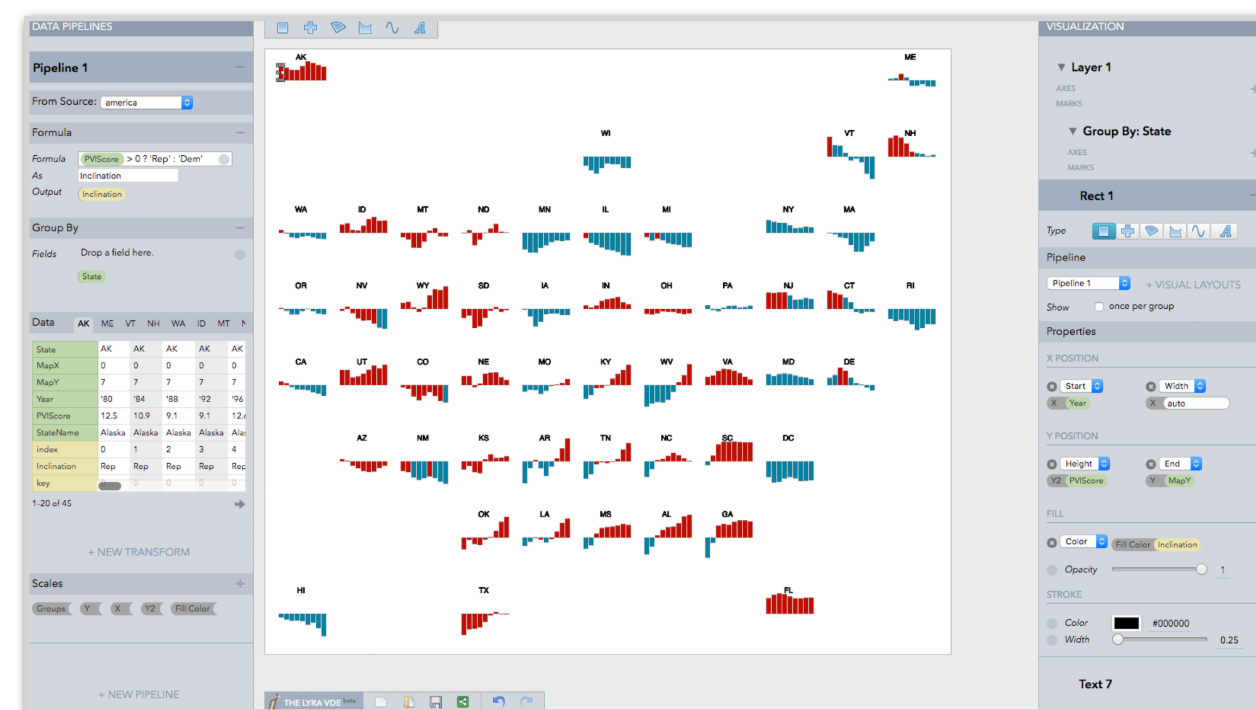
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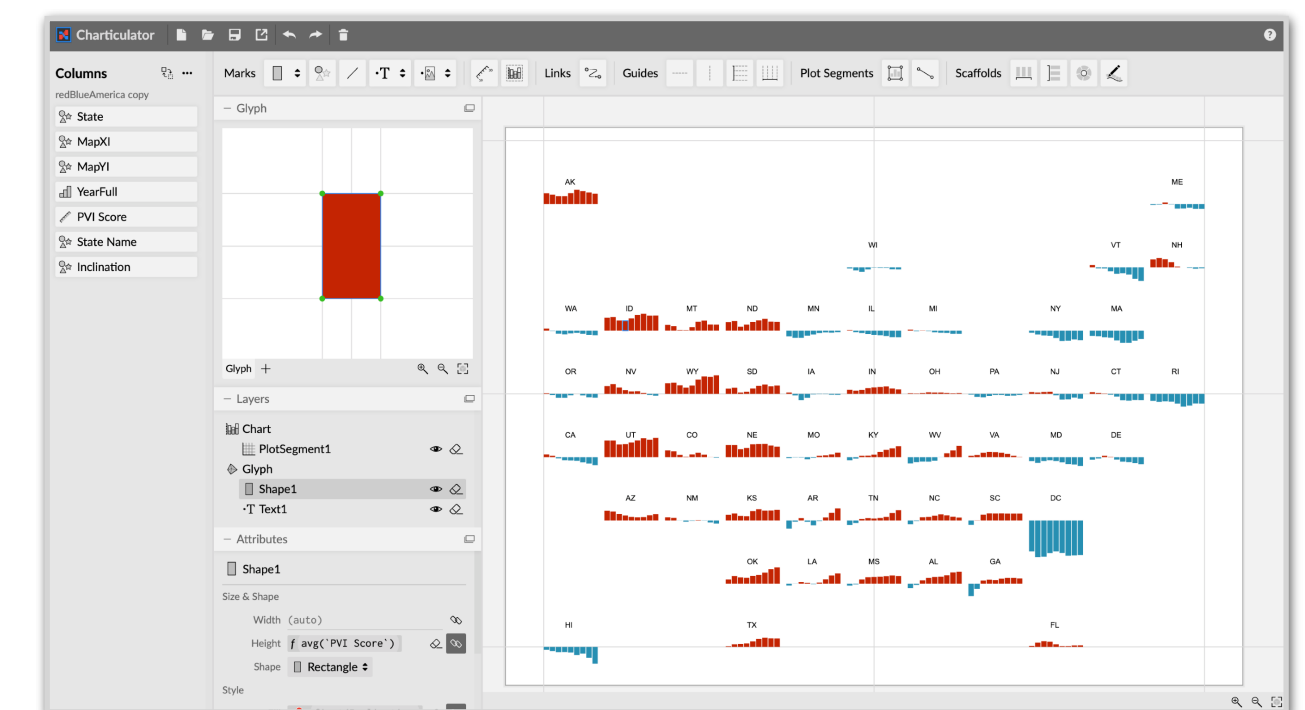
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InfoVis 2018

 **Andy Kirk**
@visualisingdata



This arms race is going to get interesting. Adobe (@dataillustrator), Microsoft (#Charticulator) and soon Google (👉) will be soon battling for a similar part of the dataviz tool market, "doing complex things simply".

twitter.com/AlbertoCairo/s...

Alberto Cairo  @AlbertoCairo

That's the old tweet. We'll launch that tool around Sep. 24, so pretty soon twitter.com/thefercook/sta...

♡ 34 1:50 PM - Sep 14, 2018



 [See Andy Kirk's other Tweets](#)



 **Data Stories Podcast**
@datastories



This week Andy Kirk @visualisingdata joins us for a roundup episode of emerging data viz tools. He says they're all attempting to do one thing in particular...but that it's particularly hard to do well. Listen for more at bit.ly/2BVa6wt.

As the authors, we know
every detail about our tools.

Compare with Traditional Evaluation Methods?

Example Gallery

Usability Study

Comparative Study

User Adoption

Compare with Traditional Evaluation Methods?

Example Gallery

▶ Lacks target user feedback

Usability Study

▶ Lacks direct comparison of tools

Comparative Study

▶ Results skewed by visualization task

User Adoption

▶ Years to gain user community

Candid comparison by system authors

Critical Reflections

What is critical reflection?

- ▶ An evaluation method
- ▶ Candid reflection

What is the goal?

- ▶ Define shared objectives and vocabulary
- ▶ Identify strengths & weaknesses
- ▶ Compare & contrast design rationale

What is required?

- ▶ Completed system
- ▶ Related systems exist

Critical Reflections

What is the process?

- ▶ Discussions & exercises by system authors
- ▶ Identify shared objectives & vocabulary
- ▶ Compare how well systems meet objectives
- ▶ Identify strengths & weaknesses
- ▶ Reveal design rationale

Details of our process

- ▶ 1 to 2 hour video conference
- ▶ 3 months
- ▶ Document meeting notes
- ▶ Synthesized detailed description & summary table

Levels of Reflection

Marks

- ▶ Mark Instantiation & Customization
- ▶ Glyph Composition
- ▶ Instantiation of Path Points & Segments
- ▶ Links between Glyphs

Data Binding

- ▶ Data Scoping for Glyphs
- ▶ Mapping Data Values to Visual Properties

Scales, Axes & Legends

- ▶ Scales
- ▶ Axes & Legends

Layout

- ▶ Relative Layout
- ▶ Layout in a Collection
- ▶ Nested Layout
- ▶ Coordinate Systems

Levels of Reflection

Marks

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- ▶ Scales
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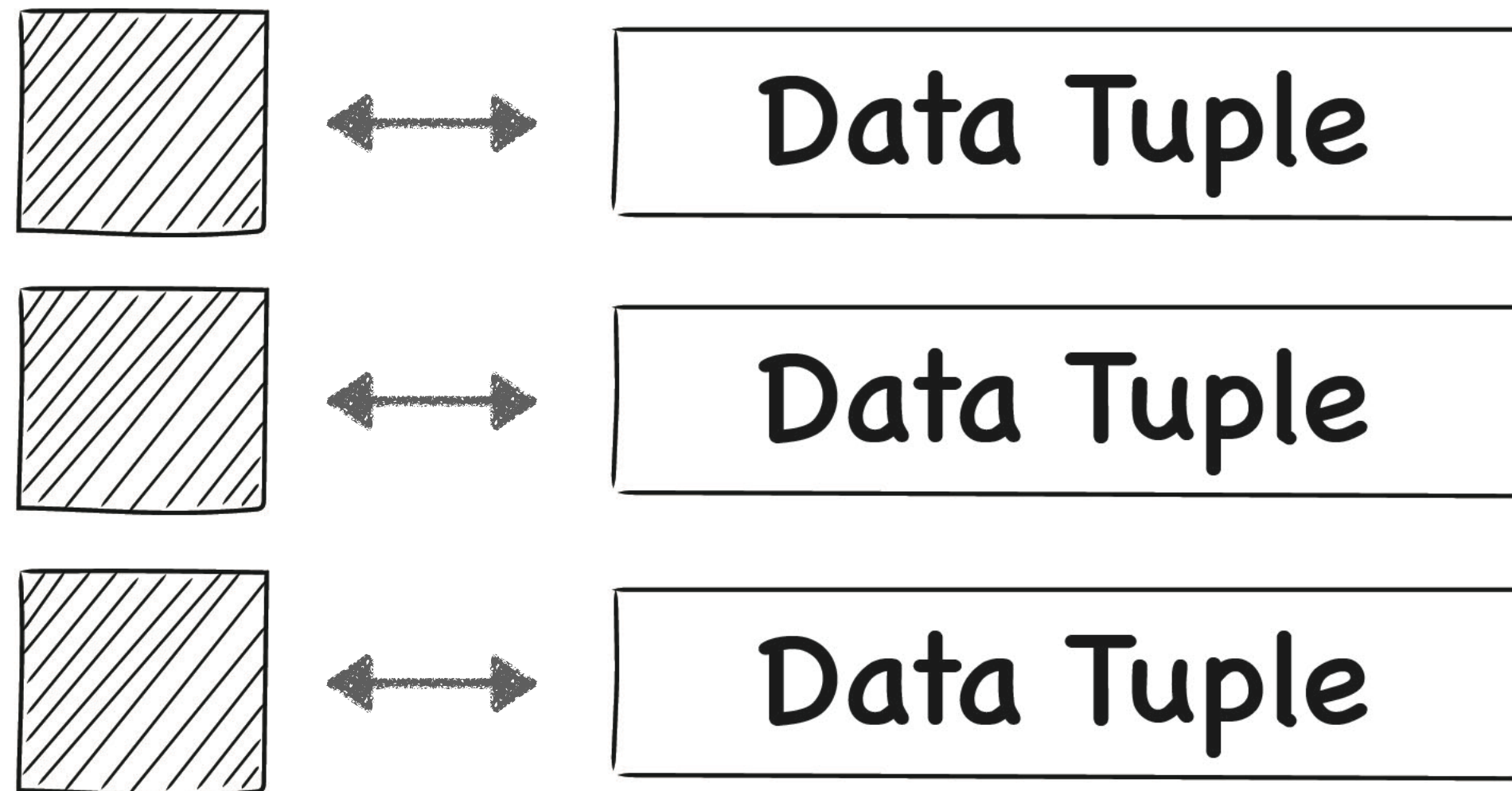
- ▶ Relative Layout
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Refer to our Paper

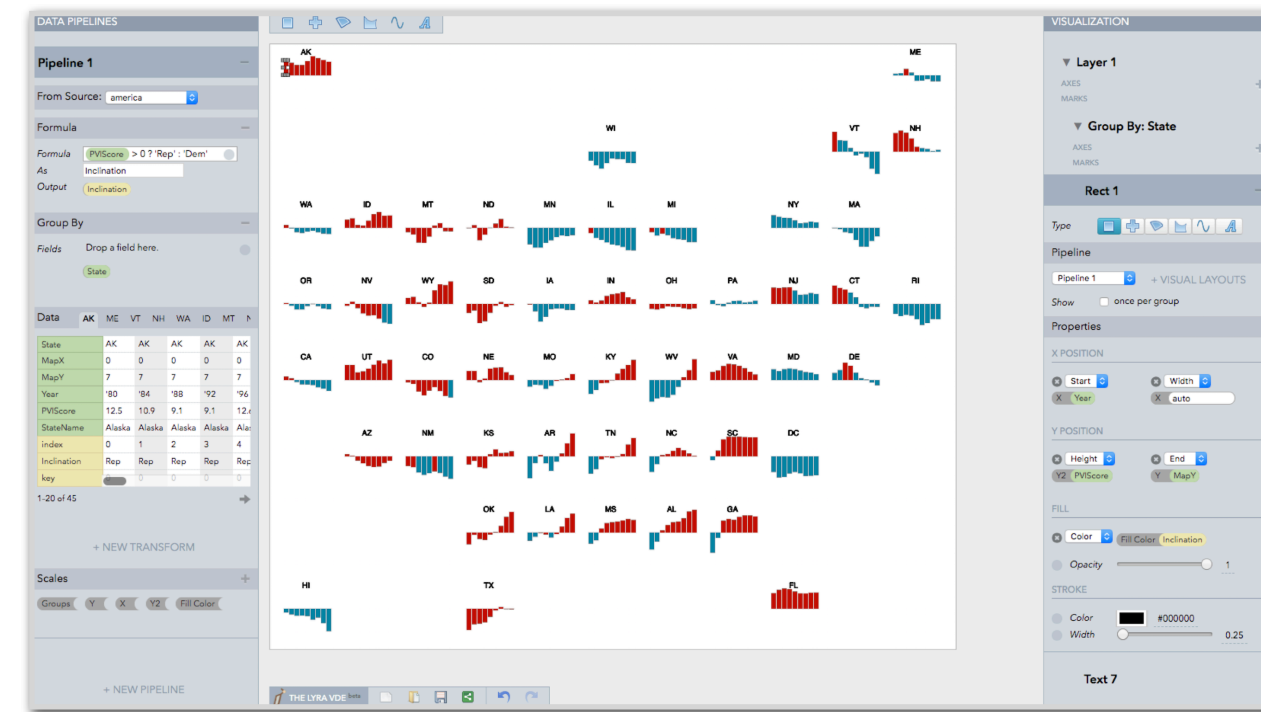
Data Binding

Generate Glyphs

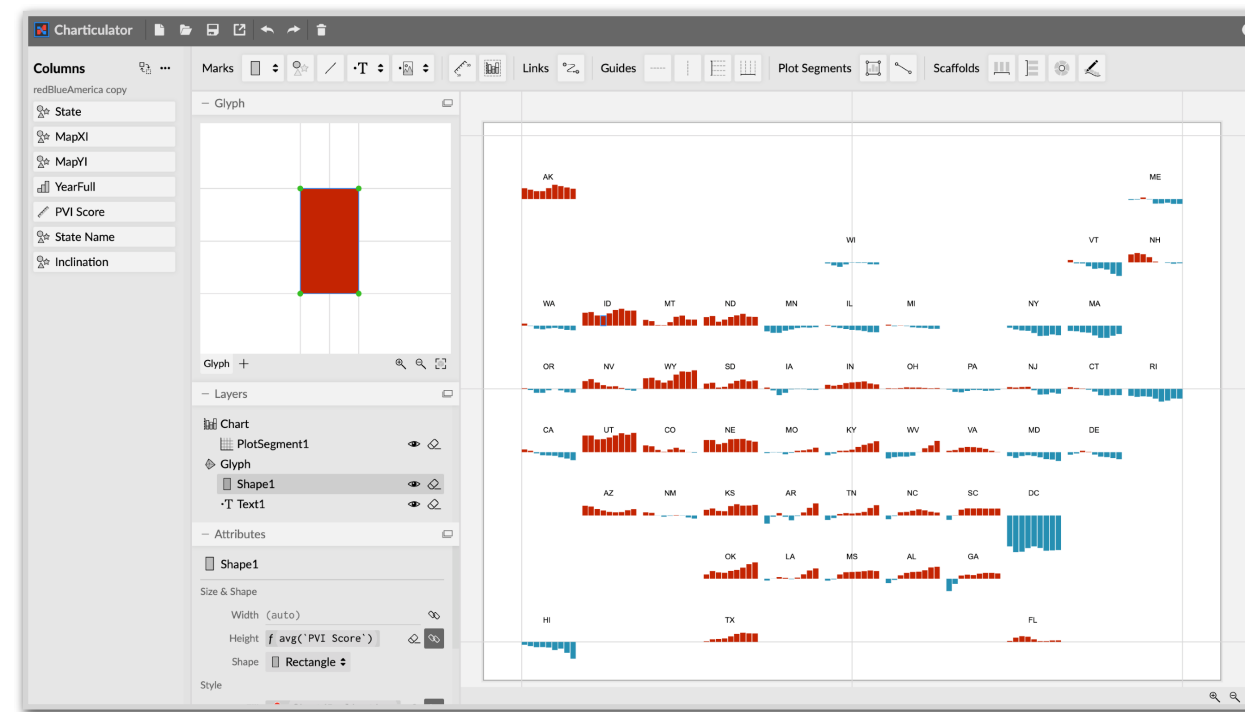
▶ Generate glyphs based on bound data



Data Binding



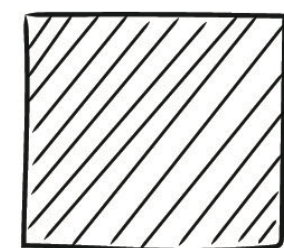
Lyra



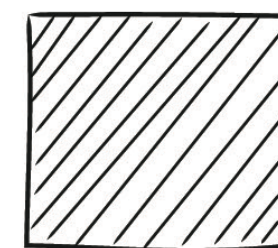
Charticulator



Data Illustrator

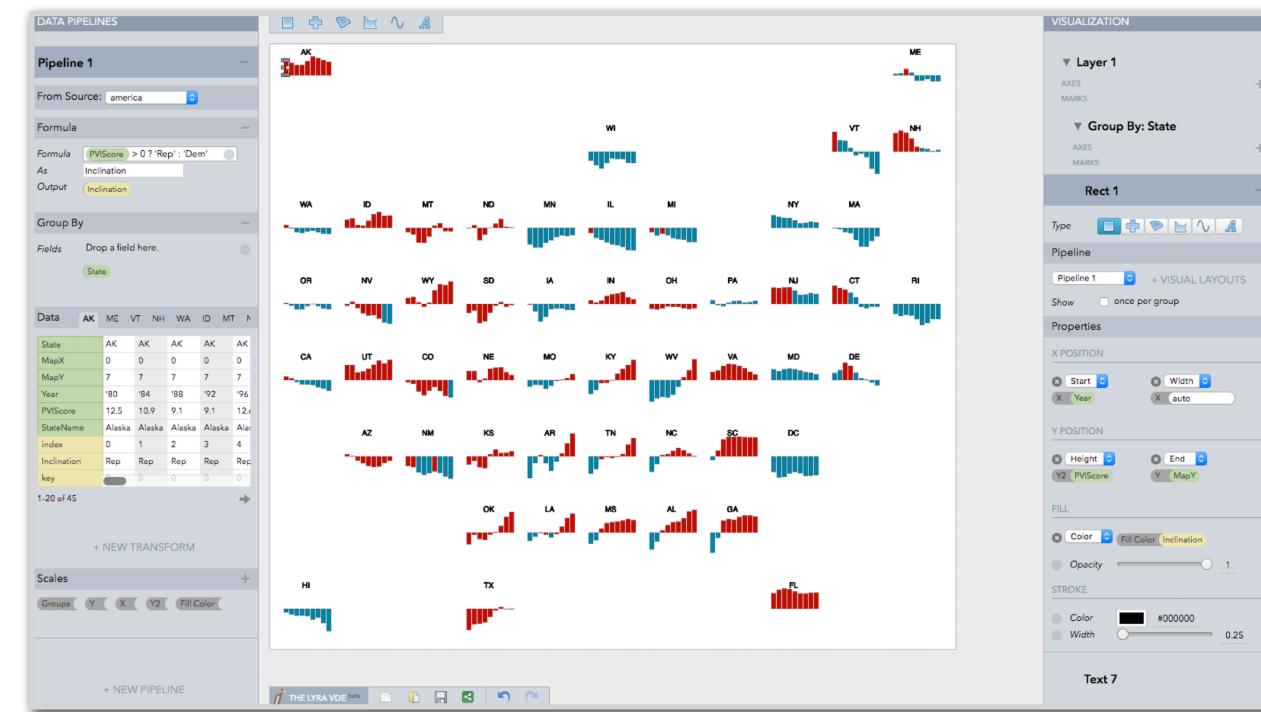


Data Tuple



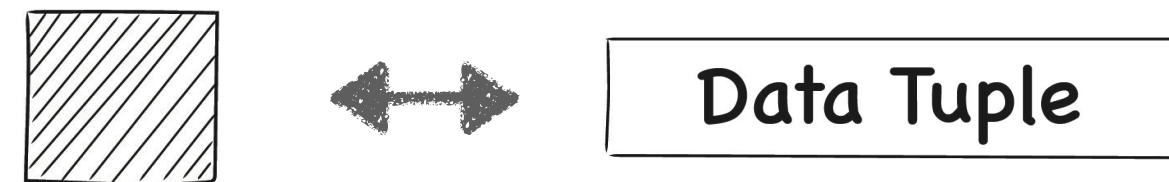
Data Tuple

Data Binding

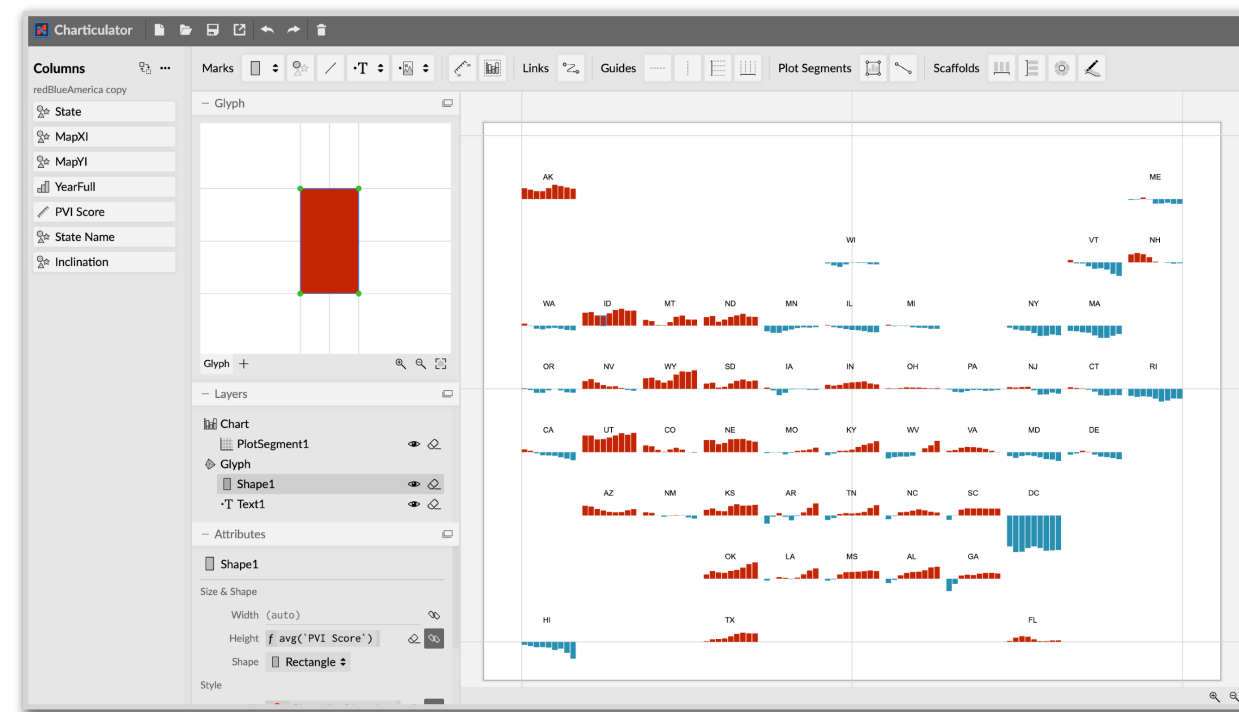
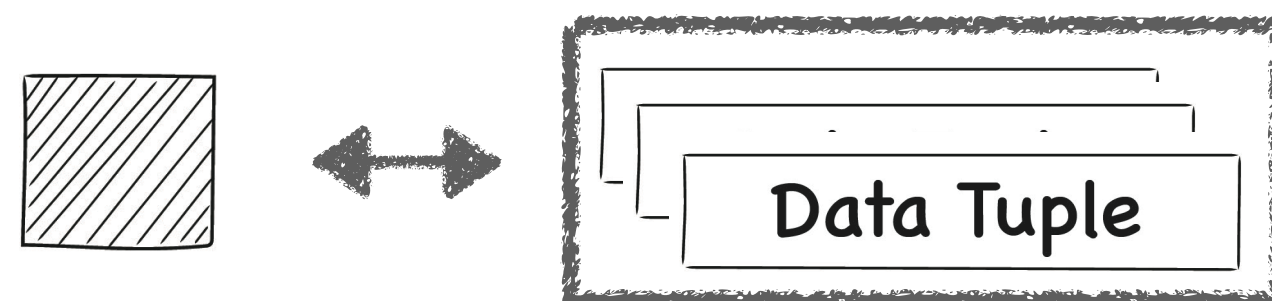


Lyra

Auto-Generate

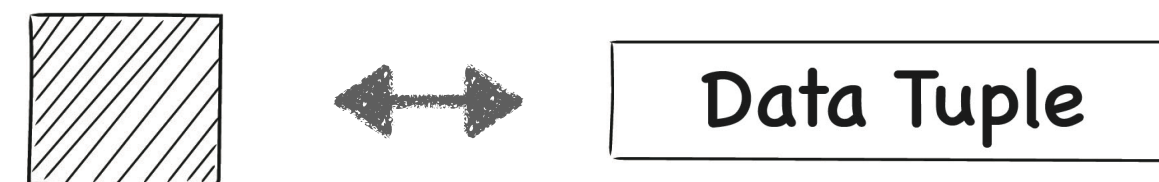


Group-By / Format

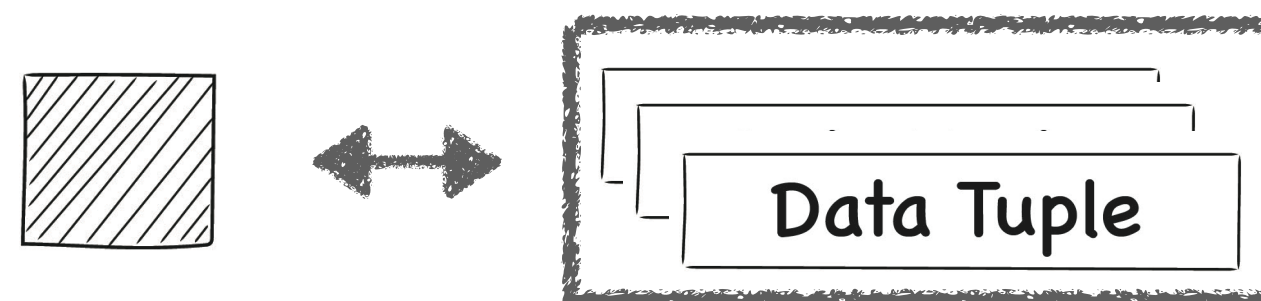


Charticulator

Auto-Generate

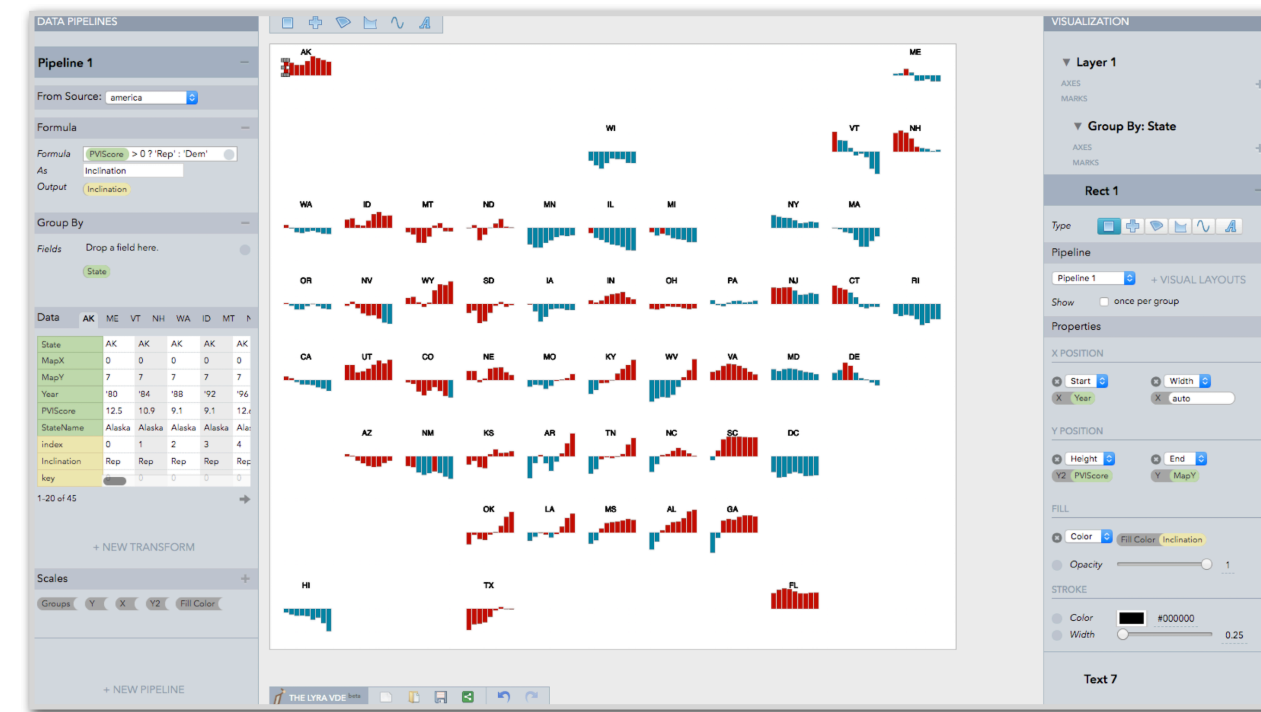


Group-By / Format



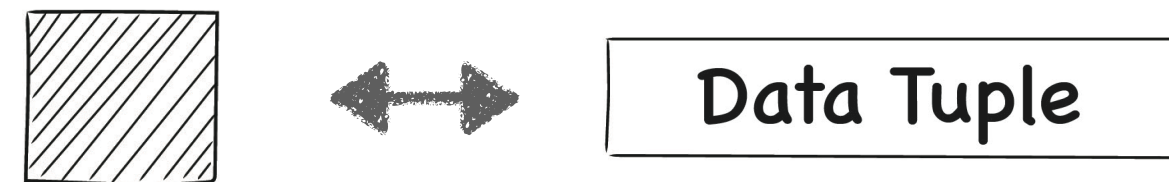
Data Illustrator

Data Binding

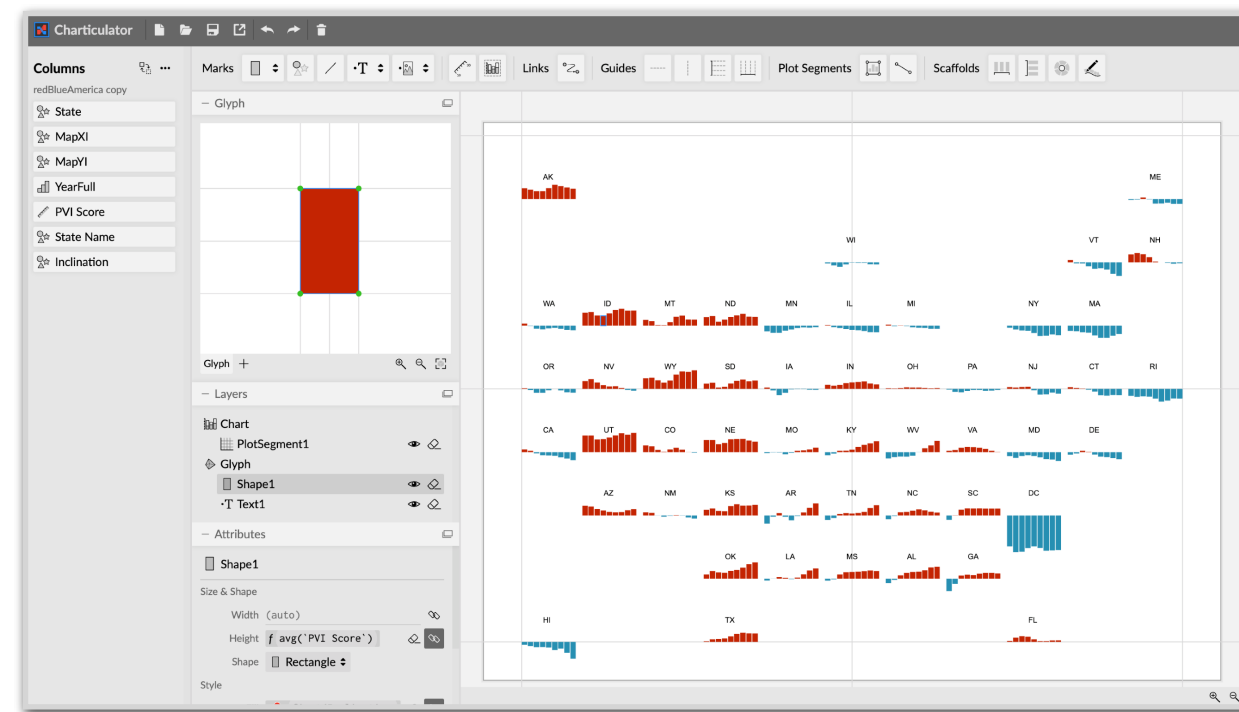
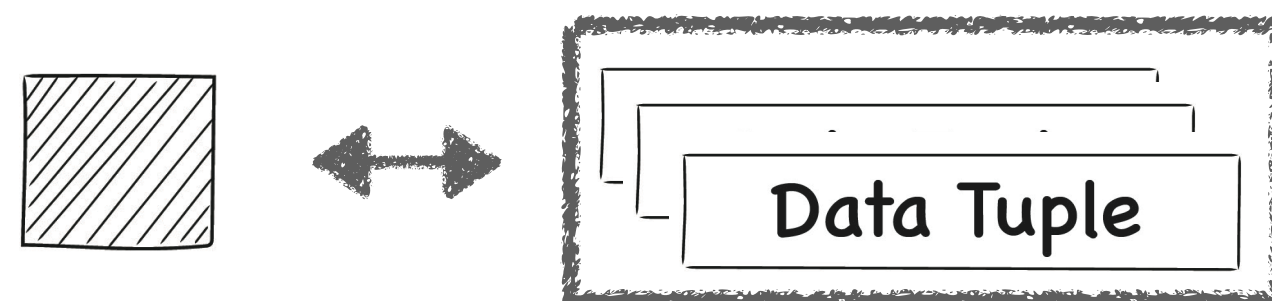


Lyra

Auto-Generate

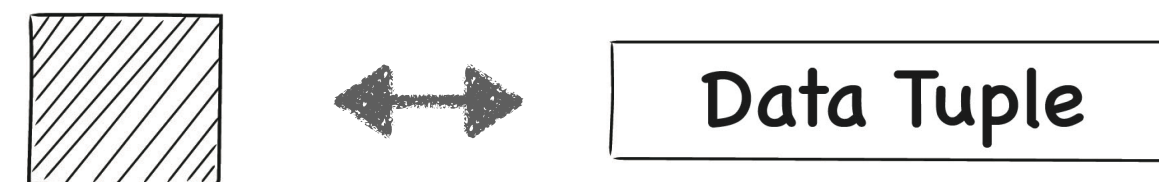


Group-By / Format

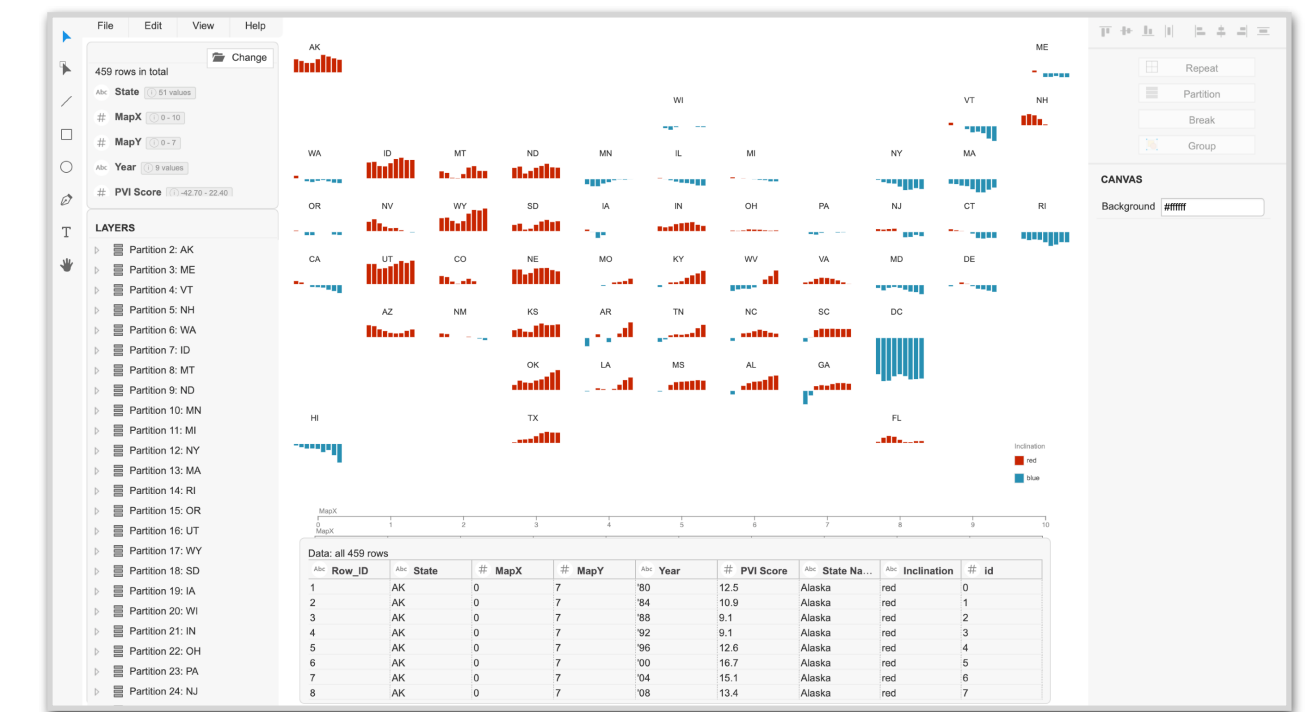
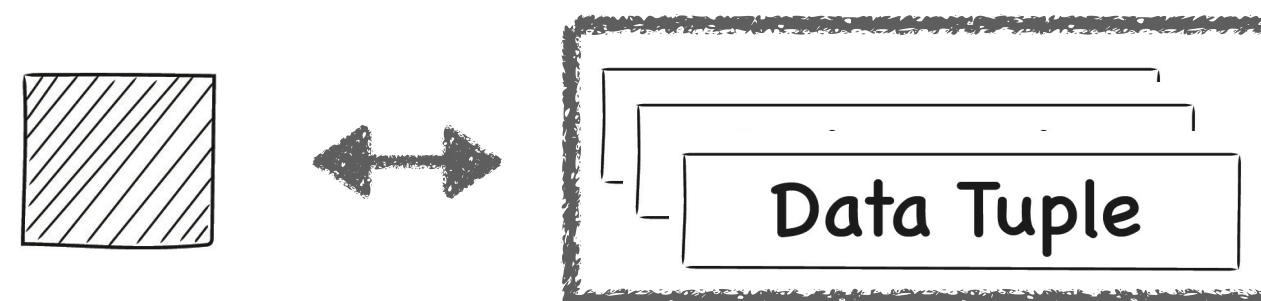


Charticulator

Auto-Generate

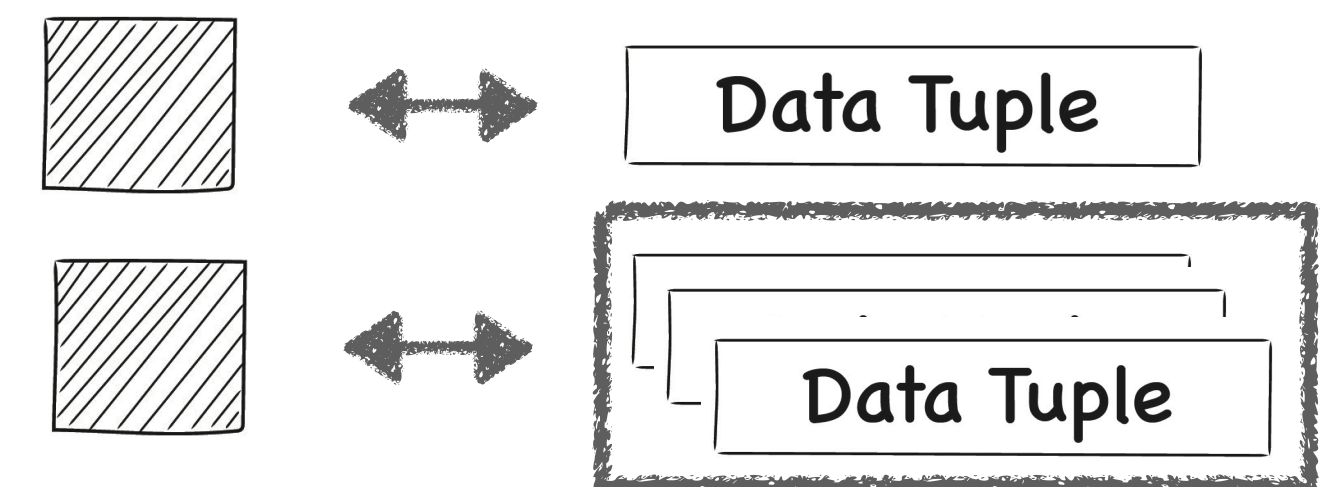


Group-By / Format

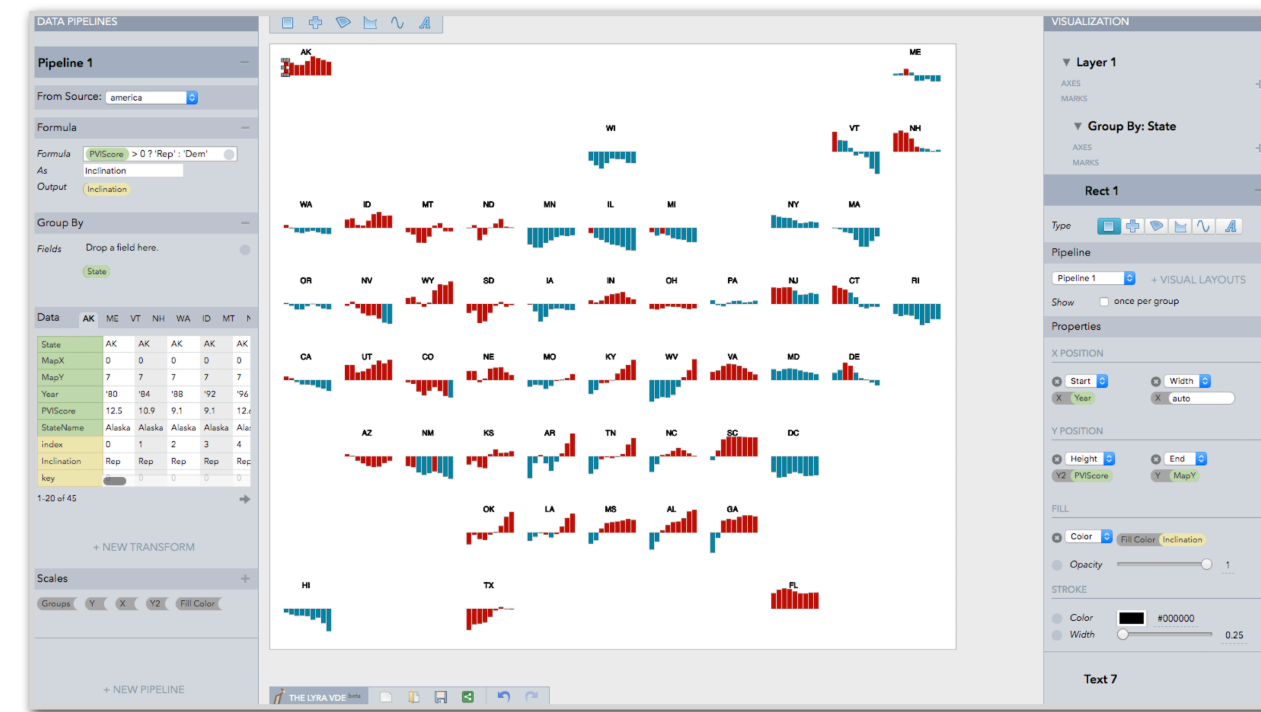


Data Illustrator

Repeat / Partition

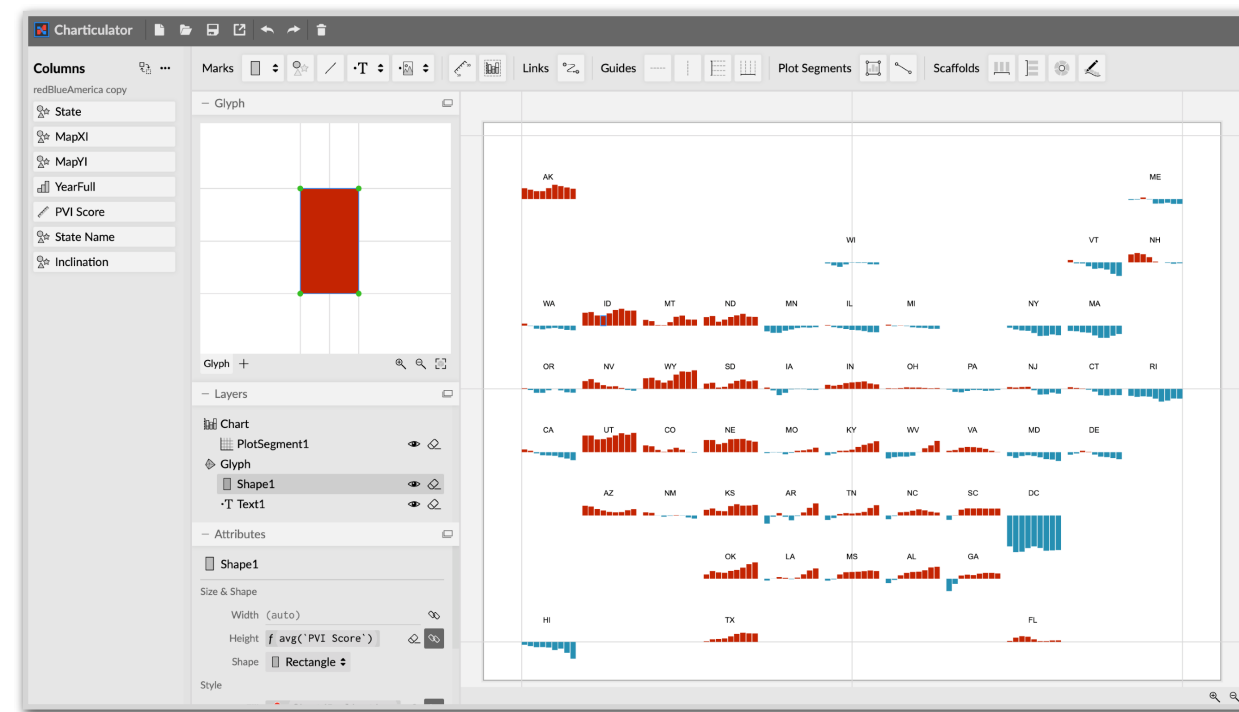


Data Binding



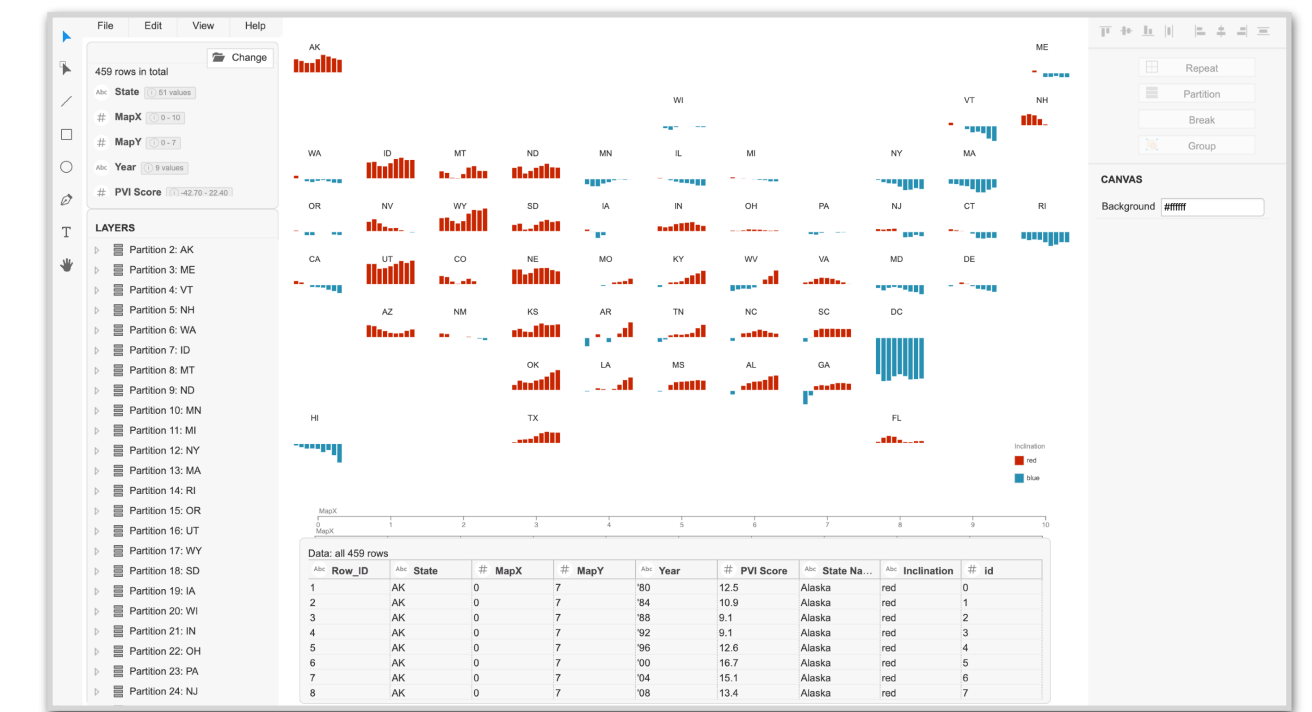
Lyra

- Quick auto-generate
- More steps to aggregate
- ▶ Glyph generation is *imperative*



Charticulator

- Quick auto-generate
- More steps to aggregate
- ▶ Glyph editor canvas has generative function

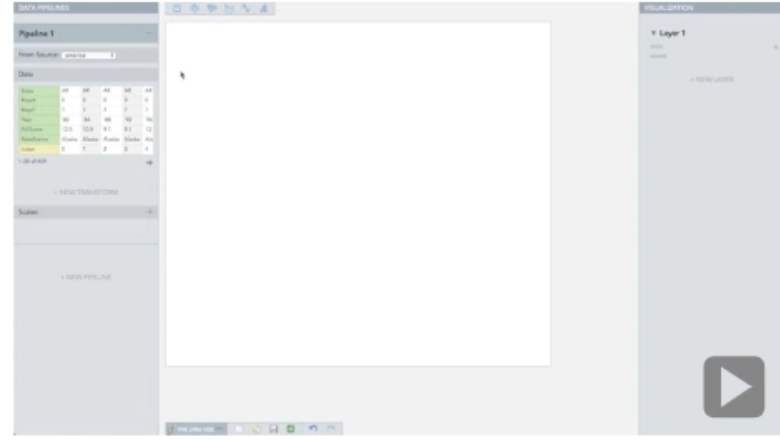
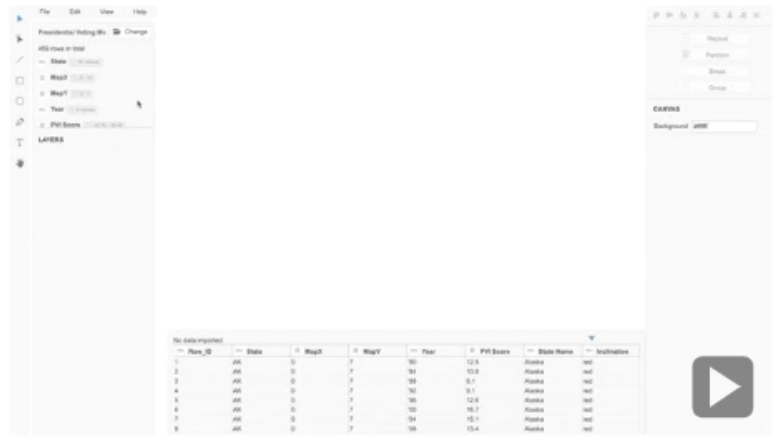
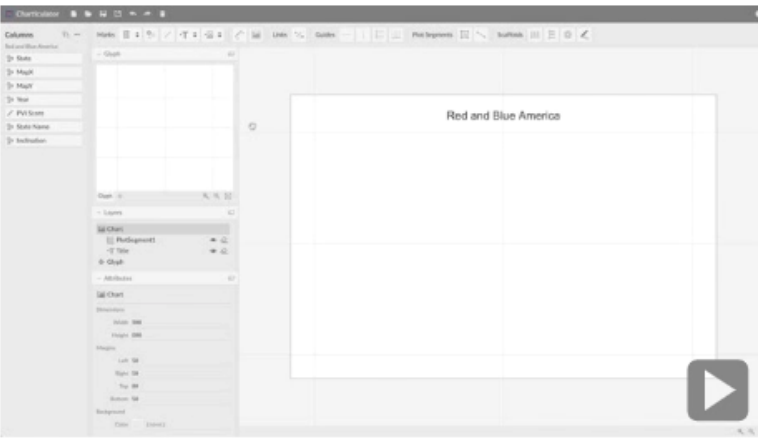
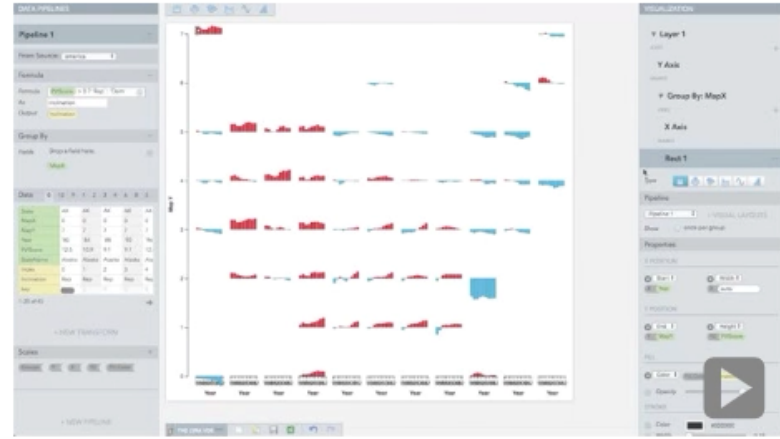
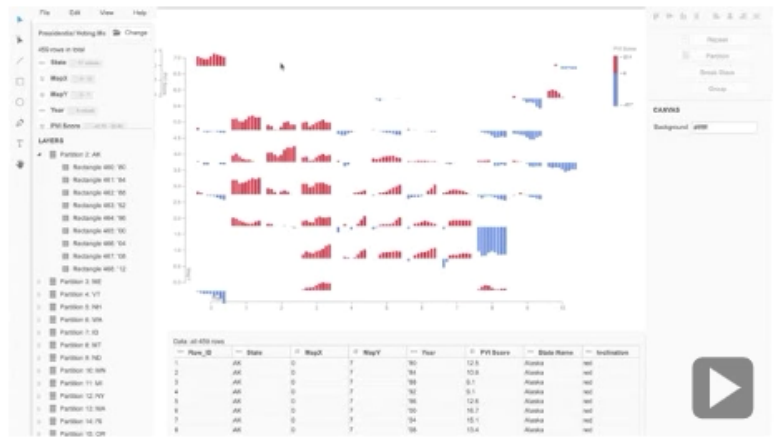
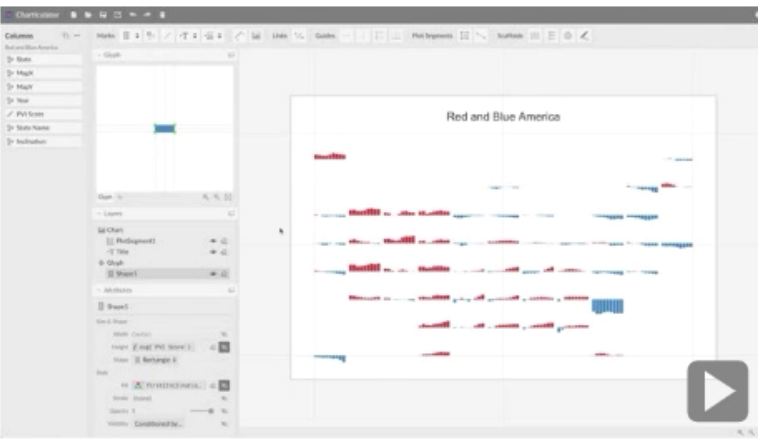


Data Illustrator

- Flexibly aggregate
- Involved click+drag interaction
- ▶ Uniform, composable actions (repeat & partition)

Summary of Main Components for the Three Systems

Video clips illustrate how to create a version of the Wall Street Journal's [A Field Guide to Red and Blue America](#), originally designed by Randy Yeip, Stuart A. Thompson and Will Welch. Click on a thumbnail to watch the corresponding video clip.

	Lyra	Data Illustrator	Charticulator
Mark Instantiation & Customization	<ul style="list-style-type: none"> W predefined marks only H drag from toolbar 	<ul style="list-style-type: none"> W custom vector shapes H draw with Pen Tool; manipulate path points & segments using Direct Selection Tool 	<ul style="list-style-type: none"> W predefined marks only H drag from toolbar; draw in glyph editor 
Glyph Composition	<ul style="list-style-type: none"> H create layers 	<ul style="list-style-type: none"> H group marks 	<ul style="list-style-type: none"> H compose in glyph editor 
Instantiation of Path Points & Path Segments	<ul style="list-style-type: none"> H map data values to point x, y positions 	<ul style="list-style-type: none"> H partition line marks; draw with Pen tool 	<ul style="list-style-type: none"> H connect glyphs using the Linking tool
Links between Glyphs	<ul style="list-style-type: none"> H add a force-directed layout transform 	<ul style="list-style-type: none"> not supported 	<ul style="list-style-type: none"> H connect glyphs using the Linking tool
Data Scoping for Glyphs	<ul style="list-style-type: none"> W one or more tuples per glyph H no user action needed for one tuple per glyph; "group by" for multiple tuples per glyph 	<ul style="list-style-type: none"> W one or more tuples per glyph H repeat or partition 	<ul style="list-style-type: none"> W one or more tuples per glyph H no user action needed for one tuple per glyph; "group by" for multiple tuples per glyph

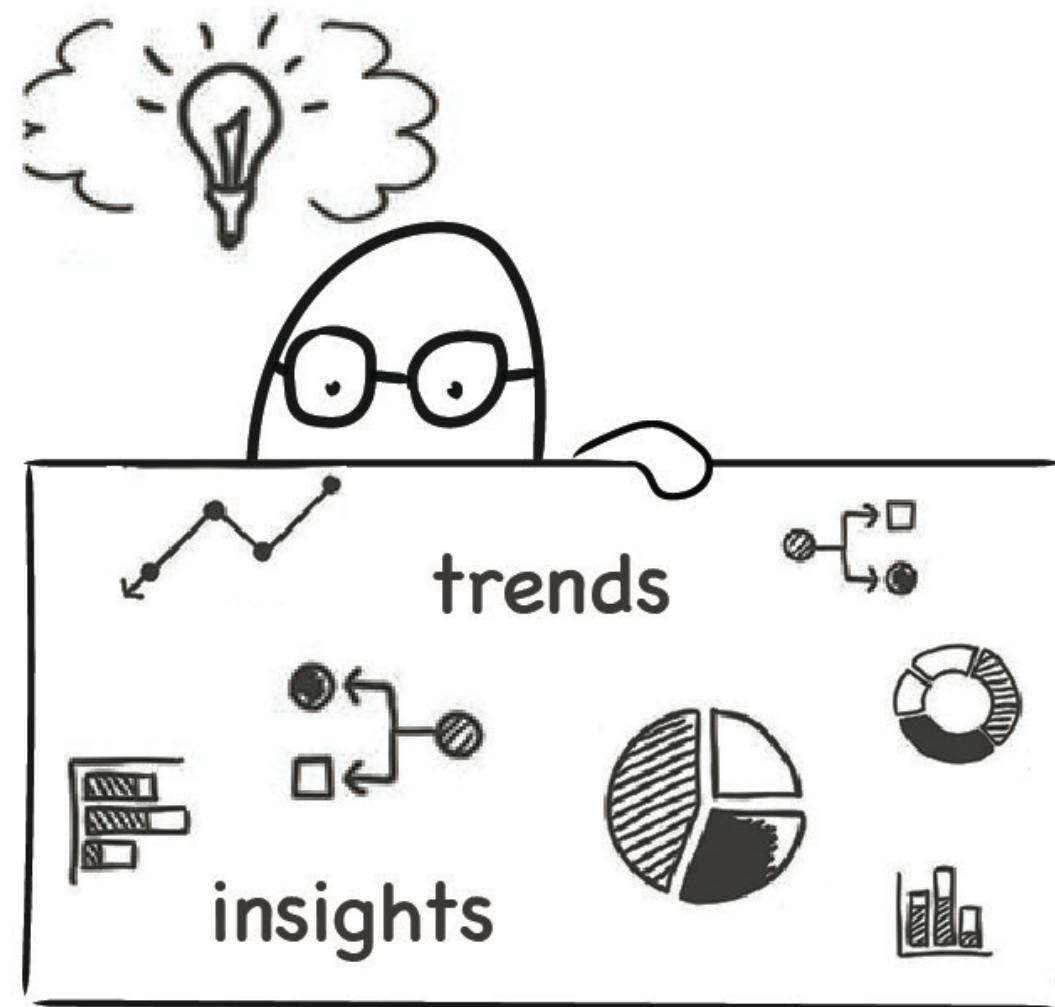
Assumptions

The “*dirty little secrets*” of our tools.

Critical reflection shines a light
on these assumptions.

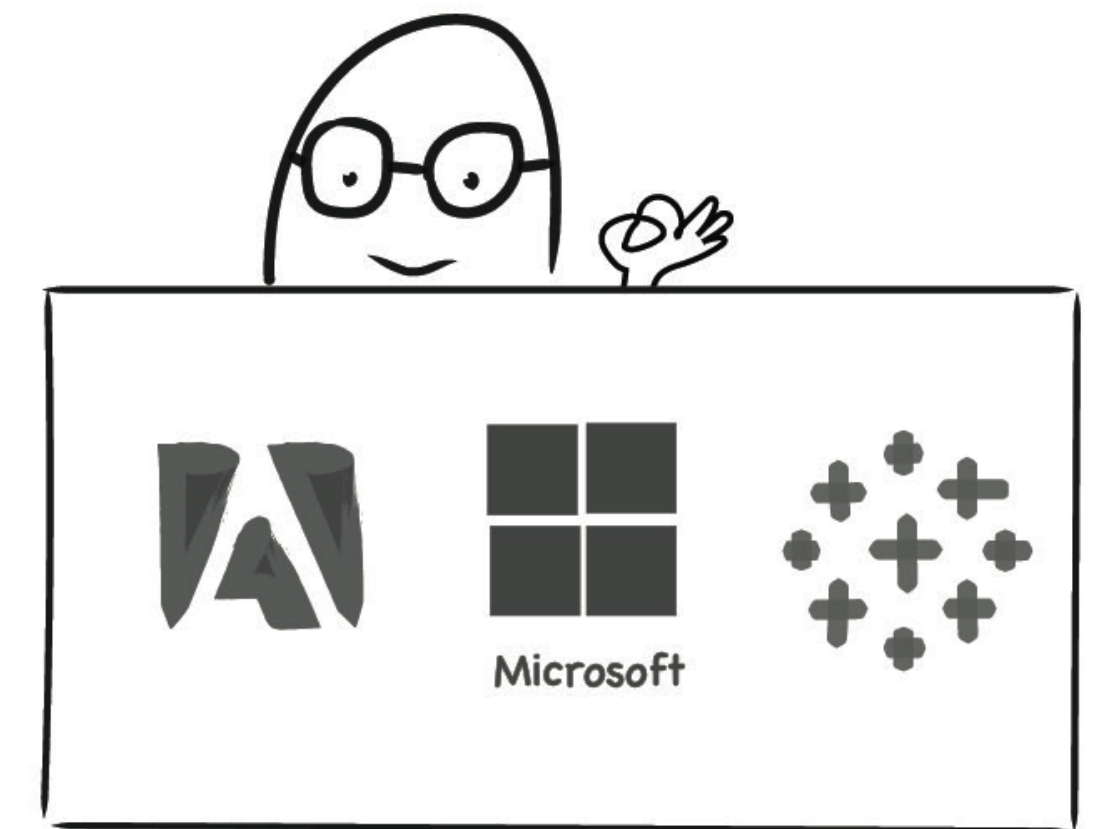
Assumptions

the user



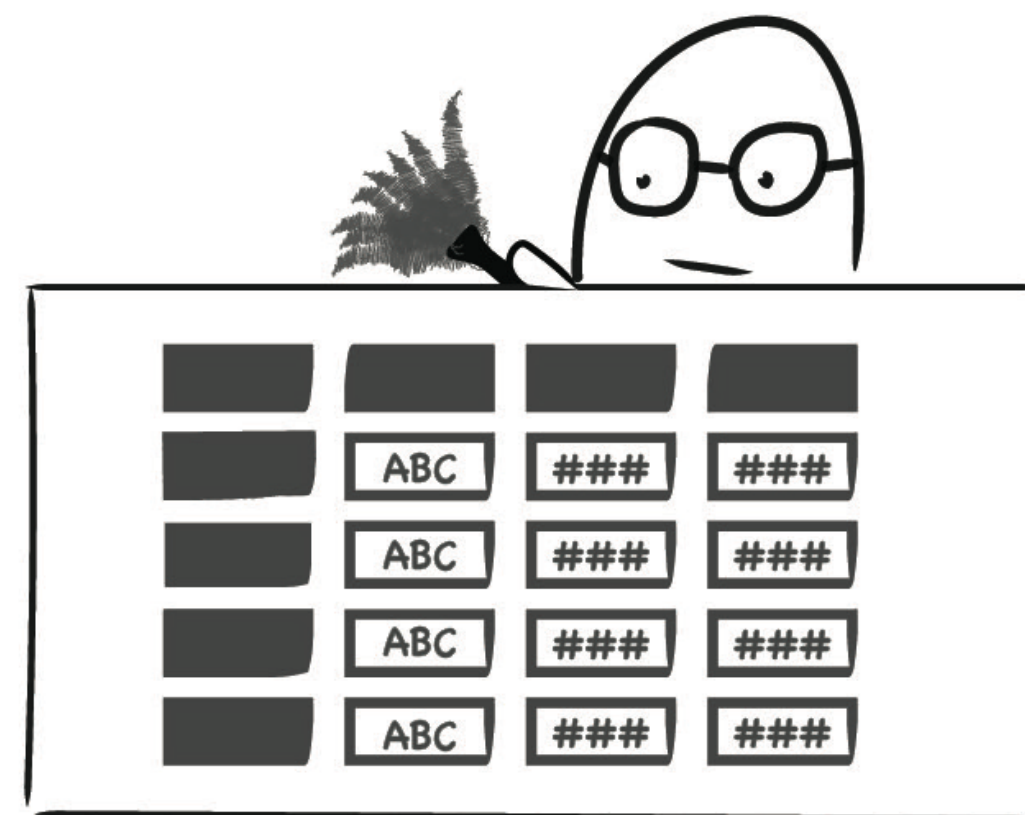
data literacy

familiar tool experience



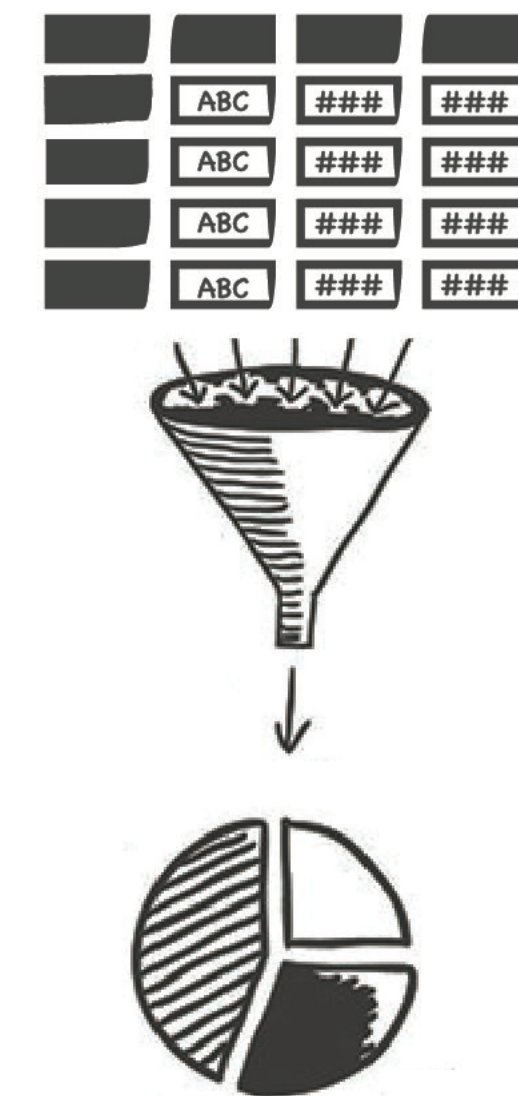
Assumptions

the data



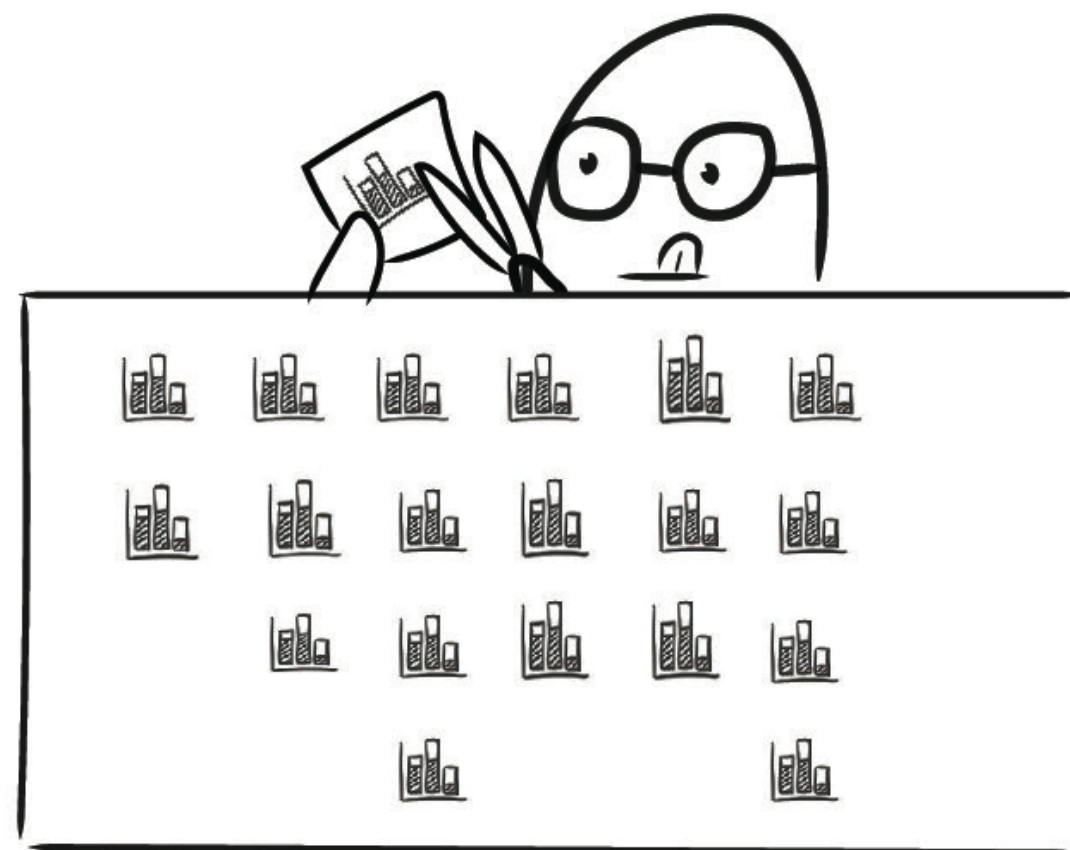
cleaned & pre-processed

“schematic congruency”



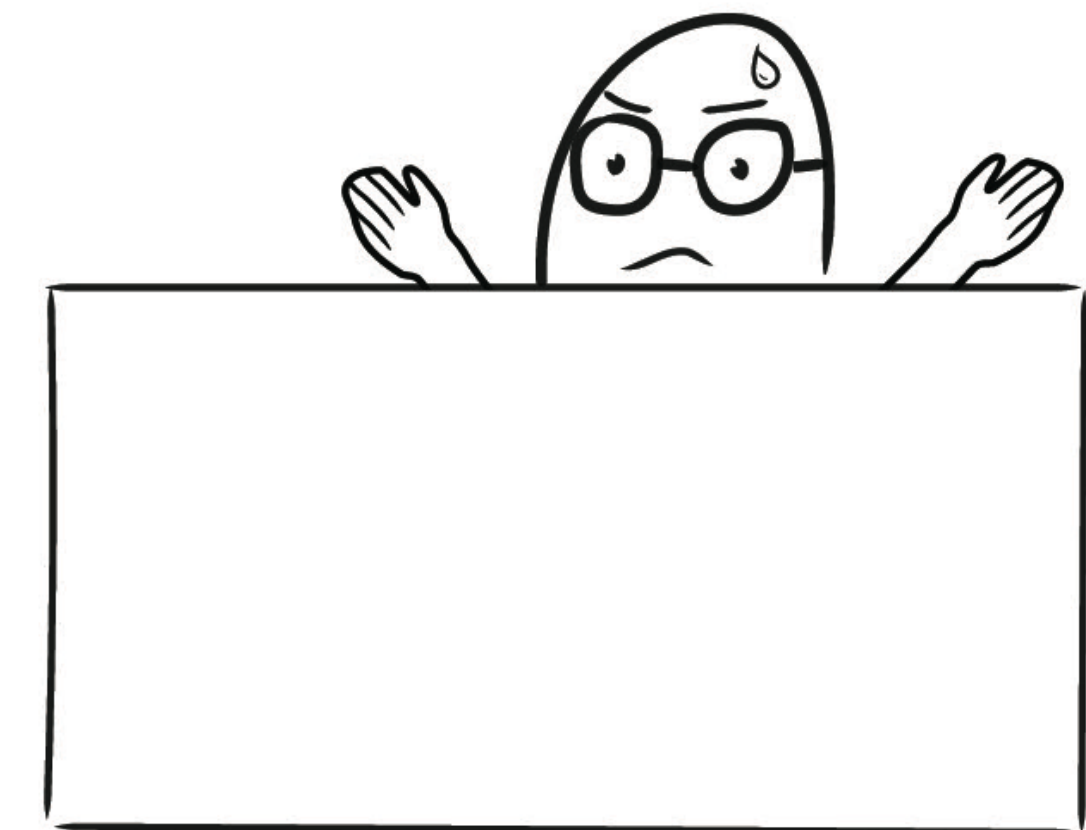
Assumptions

the task



authoring, not designing

blank canvas dilemma



Reflecting on Critical Reflections

Critical reflection as an *evaluation method*

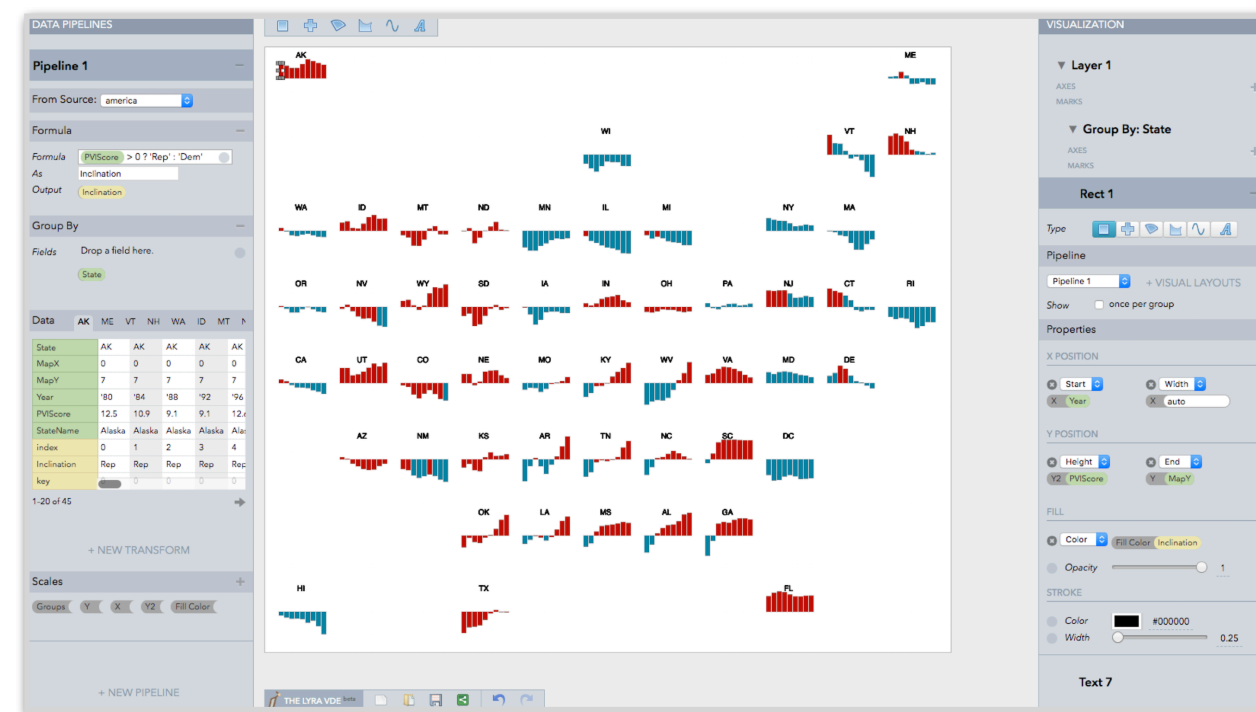
Contribute *in–depth comparisons* of our systems

Acknowledge *original assumptions* as future research directions

Thank You

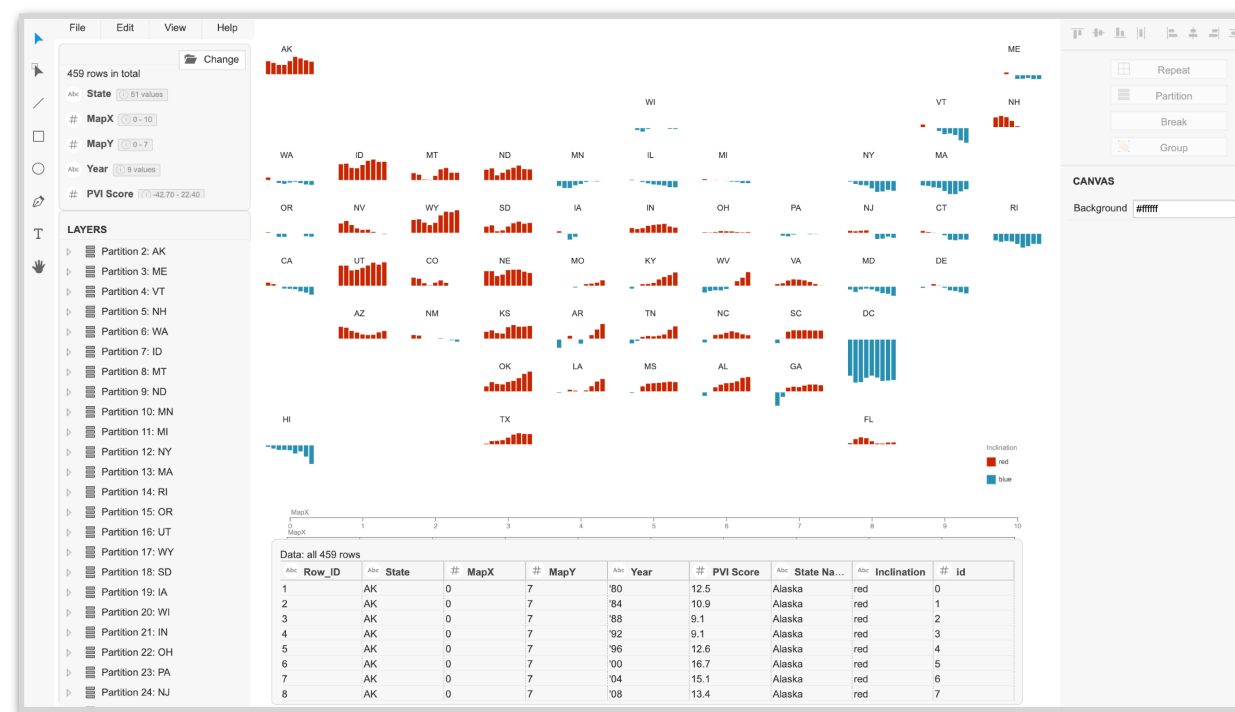
vis-tools-reflections.github.io/

Lyra



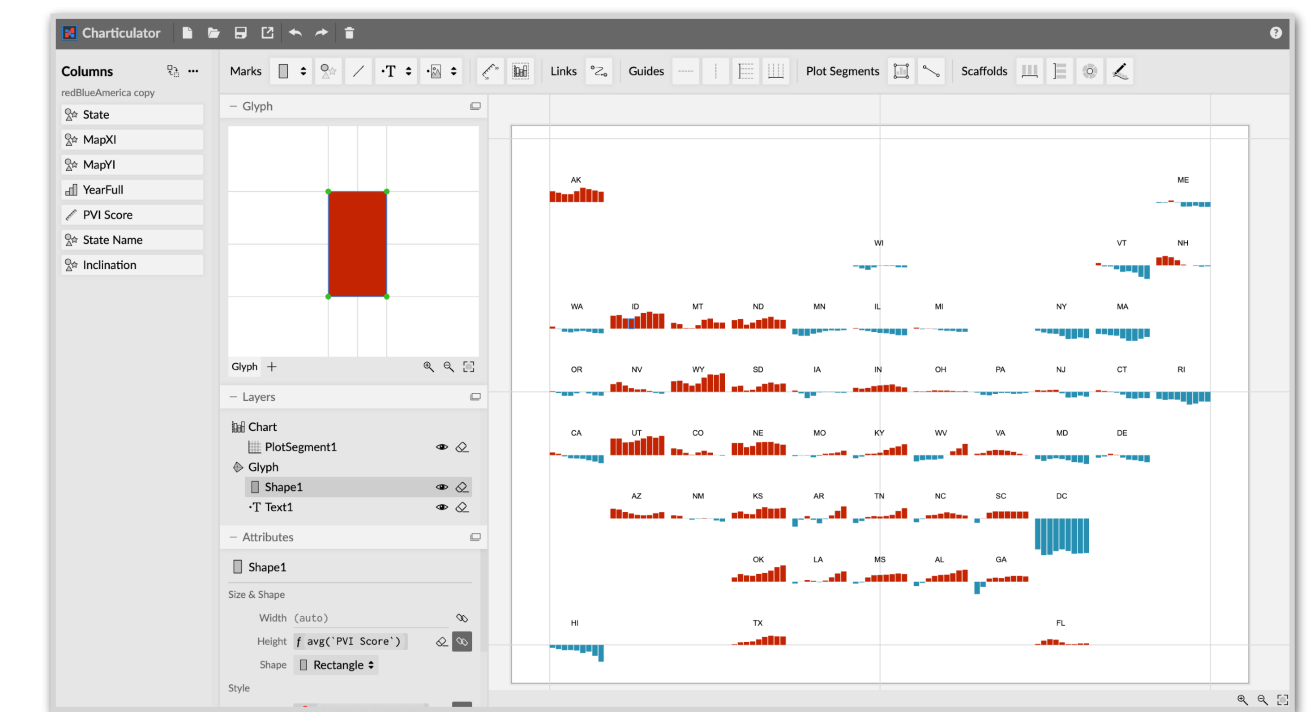
idl.cs.washington.edu/projects/lyra/

Data Illustrator



data-illustrator.com

Charticulator



charticulator.com/

