Critical Reflections on Visualization Authoring Systems

Lyra

Arvind Satyanarayan
MIT

Jeffrey Heer
U. of Washington

Data Illustrator

John Thompson
Georgia Tech

Zhicheng Liu
Adobe Research

John Stasko
Georgia Tech

Charticulator

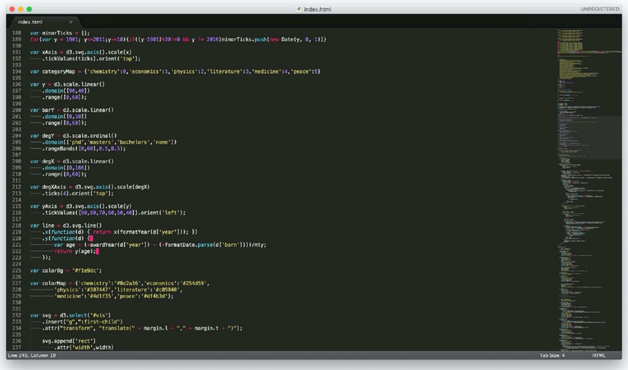
Donghao Ren
UC Santa Barbara (Apple)

Matthew Brehmer
Microsoft Research (Tableau)

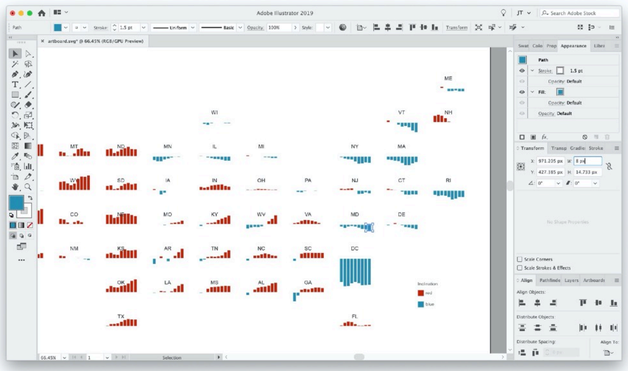
Bongshin Lee
Microsoft Research

Which Visualization Authoring Tool?

Imperative & Declarative Programming



Sketching & Vector Graphic Design Tools



Programming

Drawing

D3.js, Processing, Adobe Illustrator, Bohemian Sketch

Which Visualization Authoring Tool?

Imperative & Declarative Programming

Interactive Visualization Authoring Tools

Sketching & Vector Graphic Design Tools

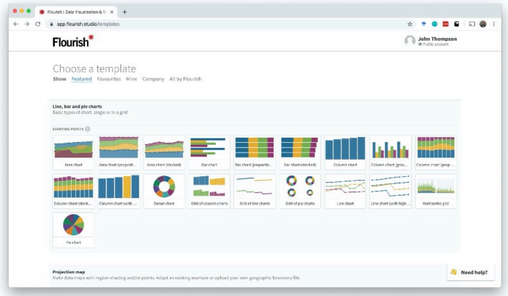
Source: Grammel et al. EuroVis '13 - A survey of visualization construction interfaces

Which Visualization Authoring Tool?

Imperative & Declarative Programming

Interactive Visualization Authoring Tools

Template Editors



Sketching & Vector Graphic Design Tools

Programming

Drawing

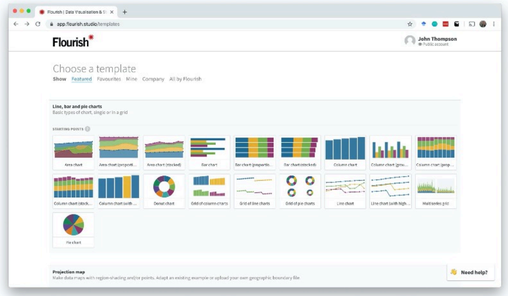
Source: Grammel et al. EuroVis '13 - A survey of visualization construction interfaces

Which Visualization Authoring Tool?

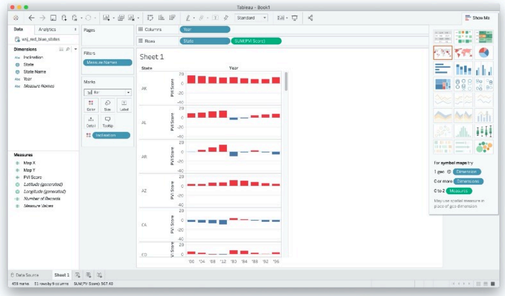
Imperative & Declarative Programming

Interactive Visualization Authoring Tools

Template Editors



Shelf Construction



Sketching & Vector Graphic Design Tools

Programming

Drawing

Source: Grammel et al. EuroVis '13 - A survey of visualization construction interfaces

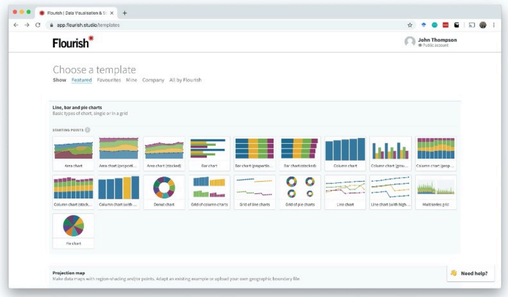
Which Visualization Authoring Tool?

Imperative & Declarative Programming

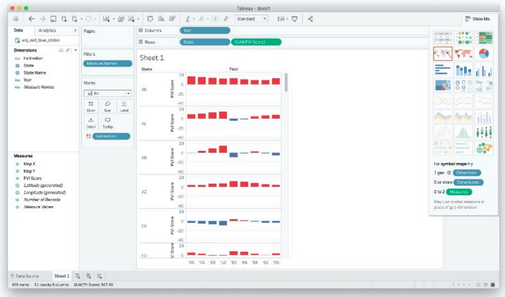
Programming

Interactive Visualization Authoring Tools

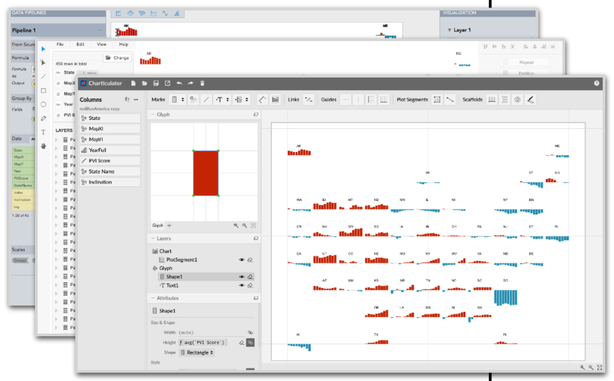
Template Editors



Shelf Construction



Visual Builders



Sketching & Vector Graphic Design Tools

Drawing

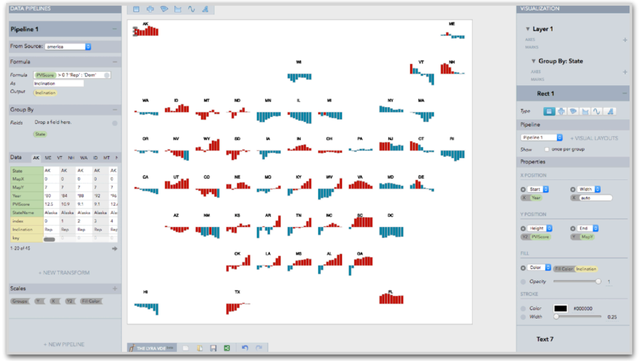
Source: Grammel et al. EuroVis '13 - A survey of visualization construction interfaces

“Can the tool build that visualization?” ⟶ Expressivity

“How easy is the system to learn?” ⟶ Learnability

Visual Builders

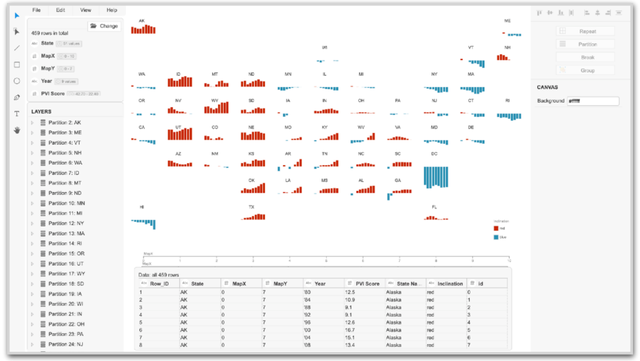
Expressive authoring of visualizations without textual programming



Lyra

Arvind Satyanarayan, Jeffrey Heer

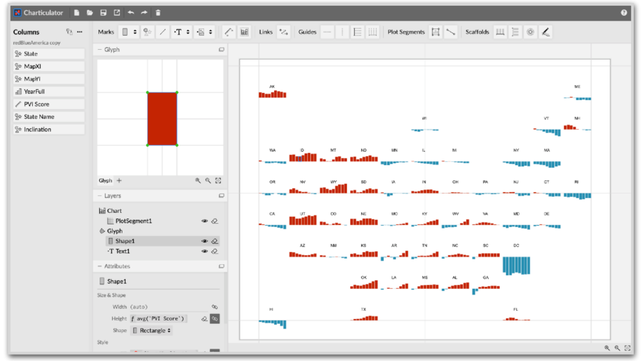
EuroVis 2014



Data Illustrator

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

CHI 2018



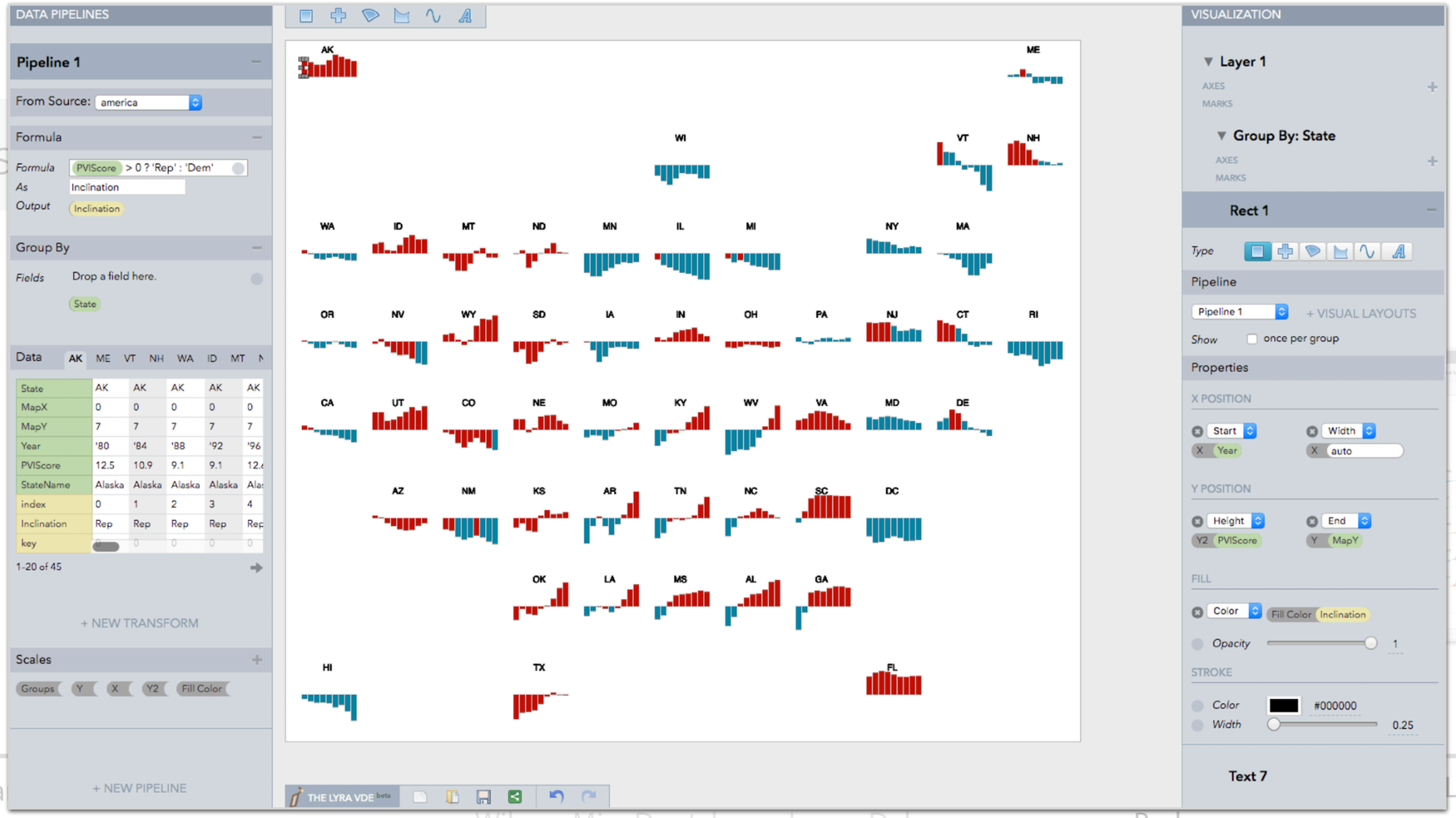
Charticulator

Donghao Ren, Bonghsin Lee, Matthew Brehmer

InfoVis 2018

Visual Builders

Express



Lyra

Arvind Satyana

EuroVis 2014

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

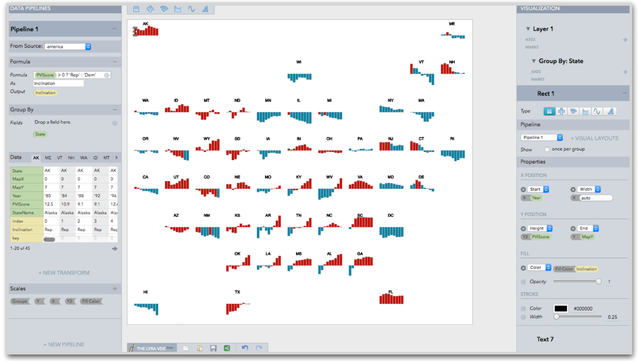
CHI 2018

Lee, Matthew Brehmer

InfoVis 2018

Visual Builders

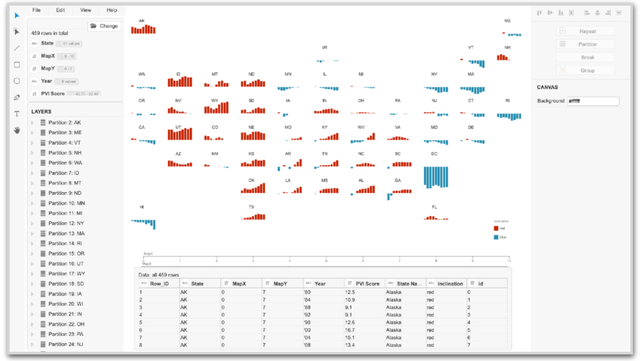
Expressive authoring of visualizations without textual programming



Lyra

Arvind Satyanarayan, Jeffrey Heer

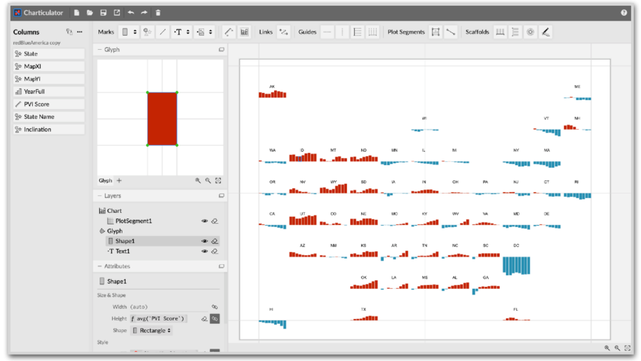
EuroVis 2014



Data Illustrator

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

CHI 2018

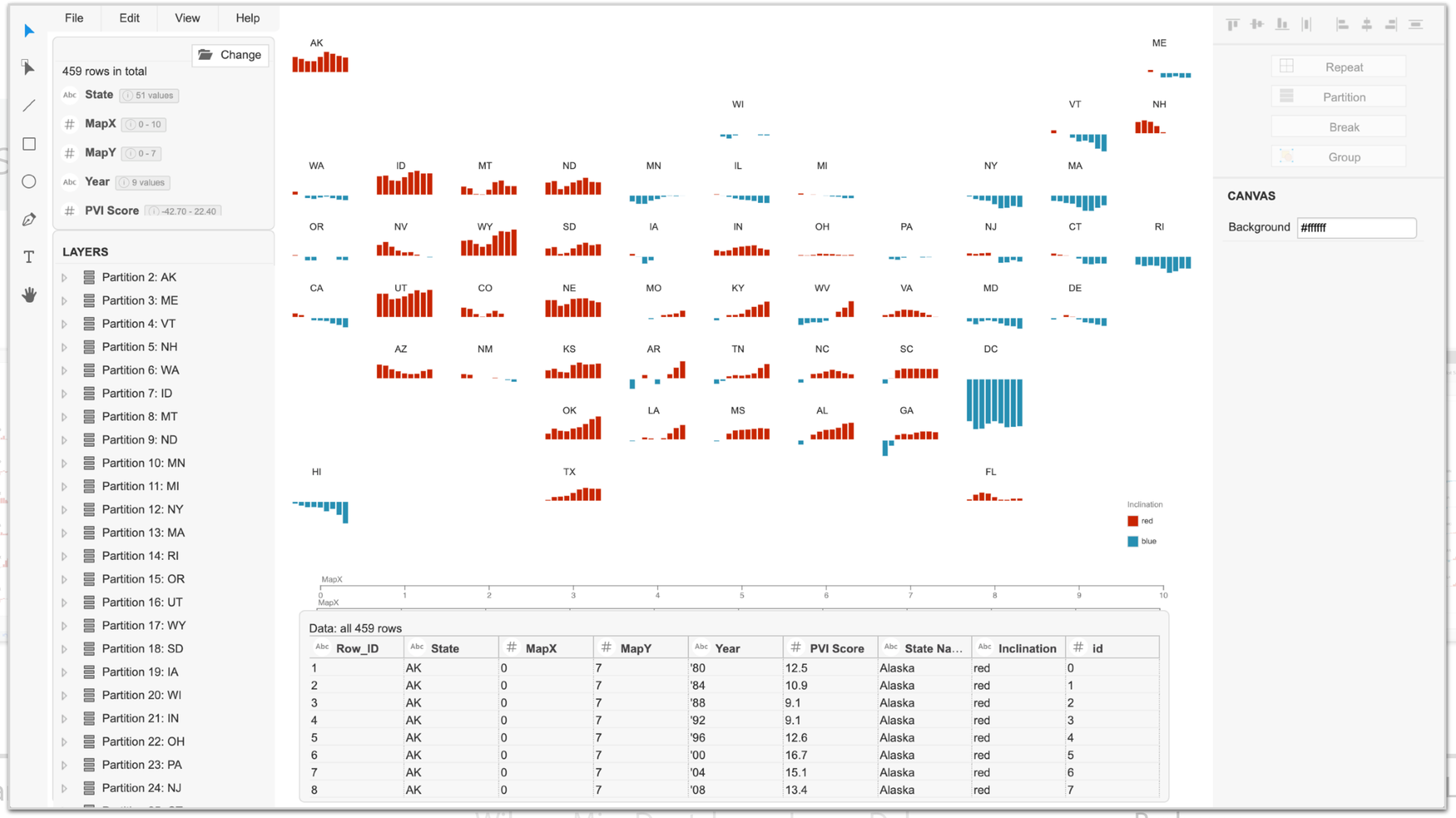


Charticulator

Donghao Ren, Bonghsin Lee, Matthew Brehmer

InfoVis 2018

Visual Builders



Express

Lyra

Arvind Satyana

EuroVis 2014

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

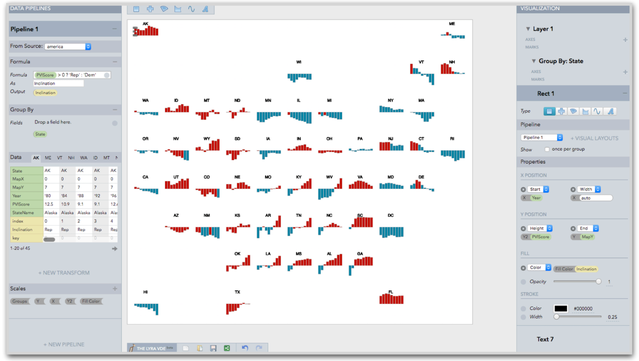
CHI 2018

Lee, Matthew
Brehmer

InfoVis 2018

Visual Builders

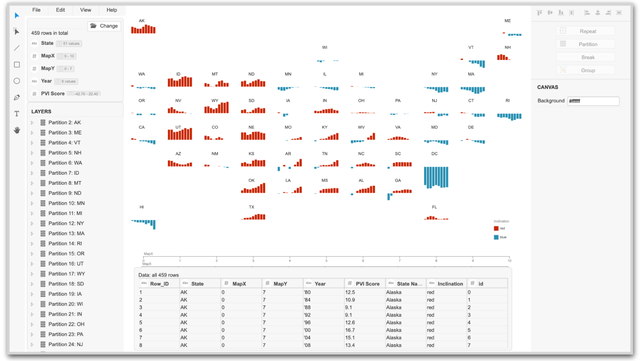
Expressive authoring of visualizations without textual programming



Lyra

Arvind Satyanarayan, Jeffrey Heer

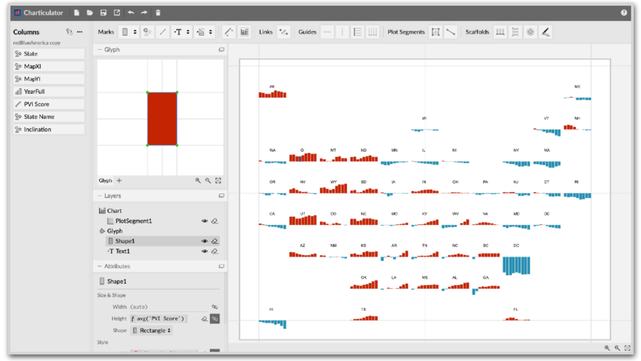
EuroVis 2014



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

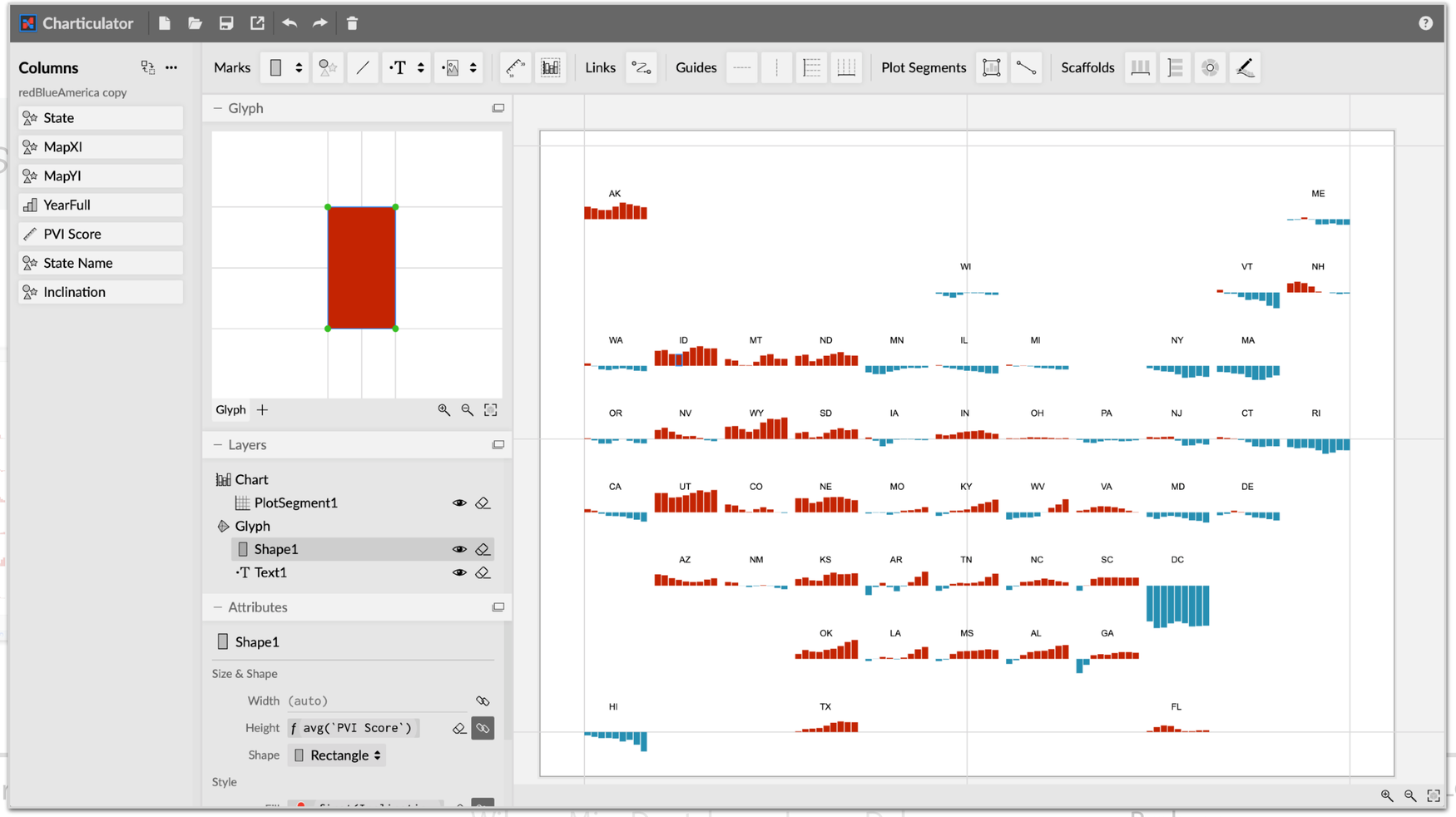
Visual Builders

Express

Lyra

Arvind Satyanar

EuroVis 2014



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

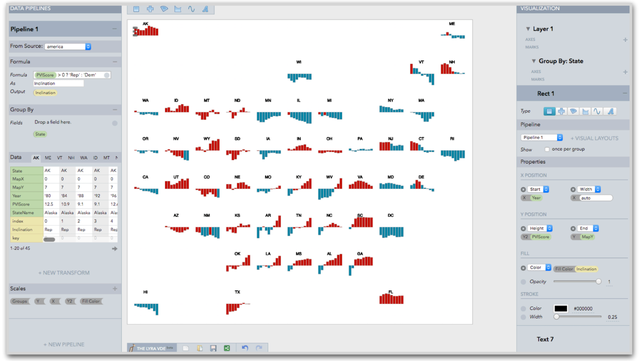
CHI 2018

Lee, Matthew Brehmer

InfoVis 2018

Visual Builders

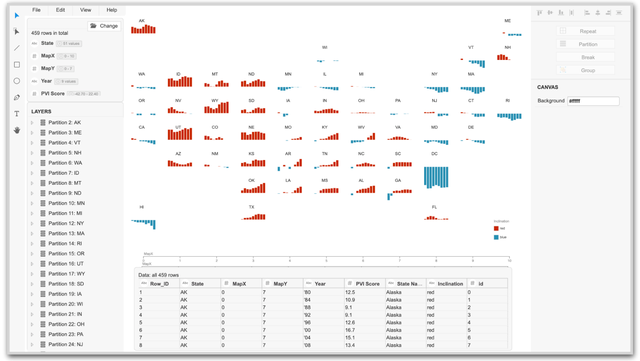
Expressive authoring of visualizations without textual programming



Lyra

Arvind Satyanarayan, Jeffrey Heer

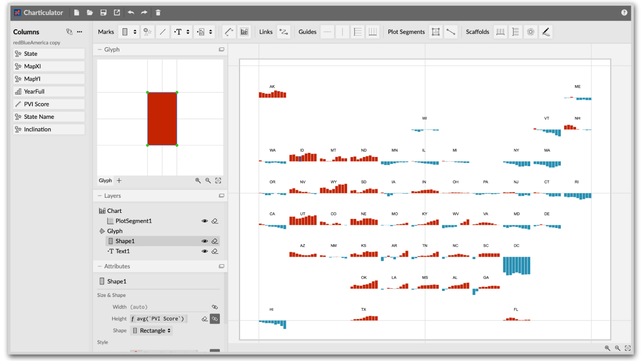
EuroVis 2014



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

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…

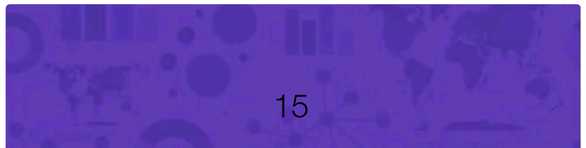
> **Alberto Cairo** @AlbertoCairo
> That's the old tweet. We'll launch that tool around Sep. 24, so pretty soon twitter.com/thefercook/sta…

♡ 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.



Source: Twitter

As the authors, we know

every detail about our tools.

Compare with Traditional Evaluation Methods?

Example Gallery

Usability Study

Comparative Study

User Adoption

Source: Ren et al. BELIV '18 - Reflecting on the evaluation of visualization authoring systems

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

Source: Ren et al. BELIV '18 - Reflecting on the evaluation of visualization authoring systems

Candid comparison by system authors

Critical Reflections

What is critical reflection?

- An evaluation method
- Candid reflection

What is required?

- Completed system
- Related systems exist

What is the goal?

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

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

Scales, Axes & Legends

- Scales
- Axes & Legends

Data Binding

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

Layout

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

Levels of Reflection

Refer to our Paper

Marks

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

Scales, Axes & Legends

- Scales
- Axes & Legends

Data Binding

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

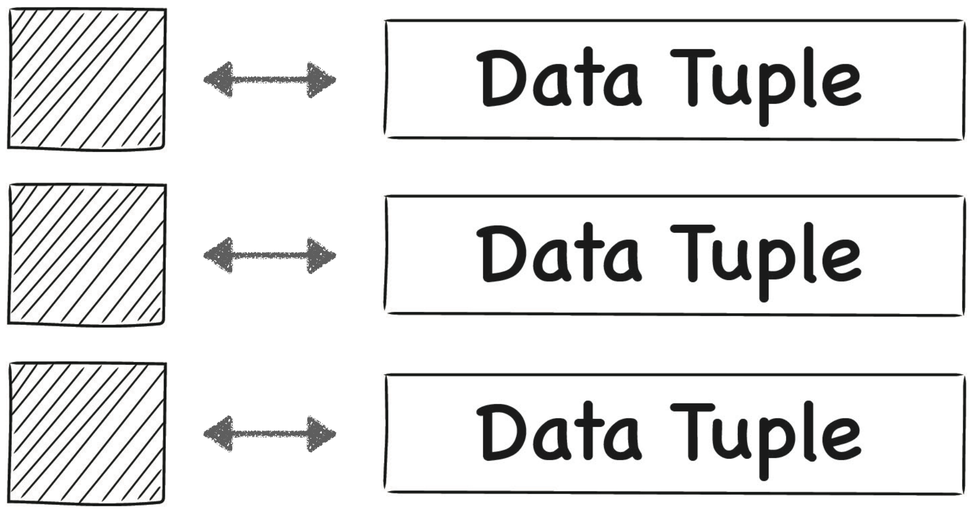
Layout

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

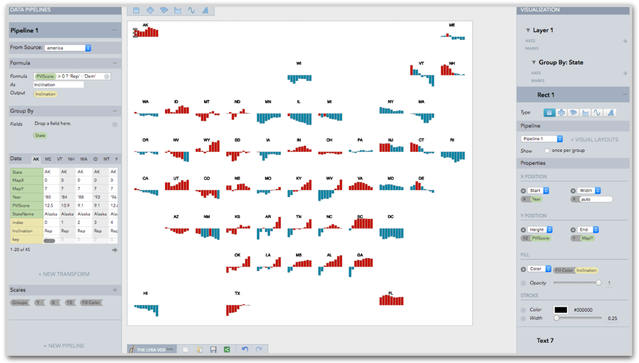
Data Binding

Generate Glyphs

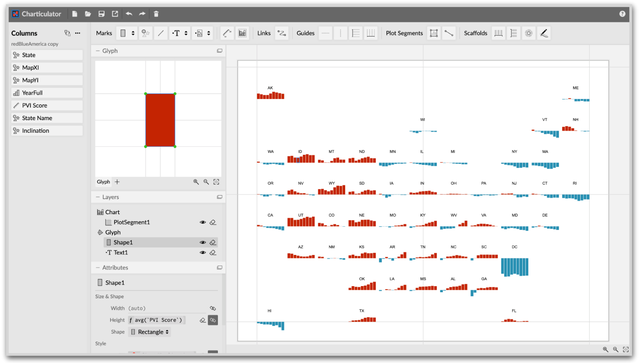
- Generate glyphs based on bound data



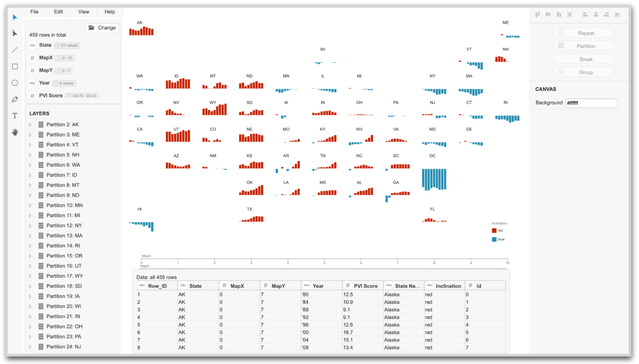
Data Binding



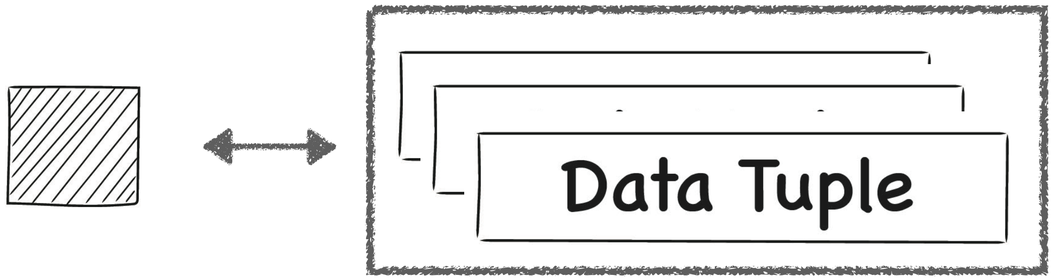
Lyra



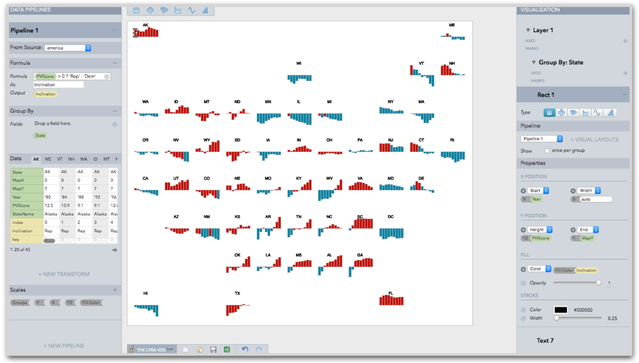
Charticulator



Data Illustrator



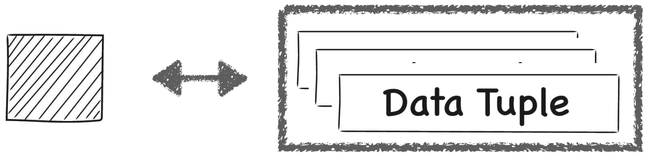
Data Binding

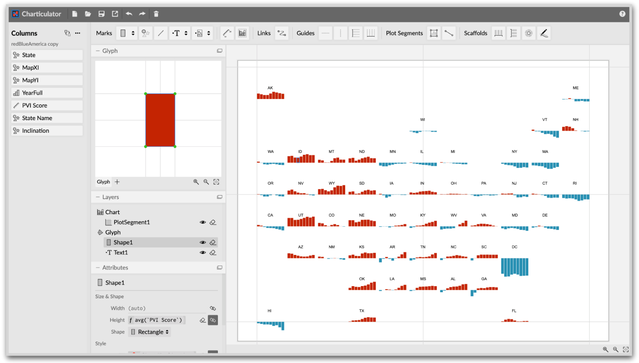


Lyra

Auto-Generate

Group-By / Format

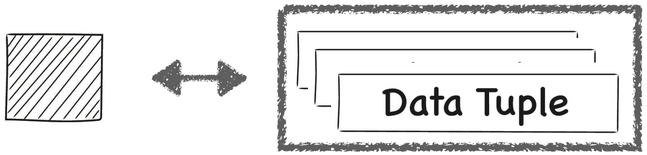


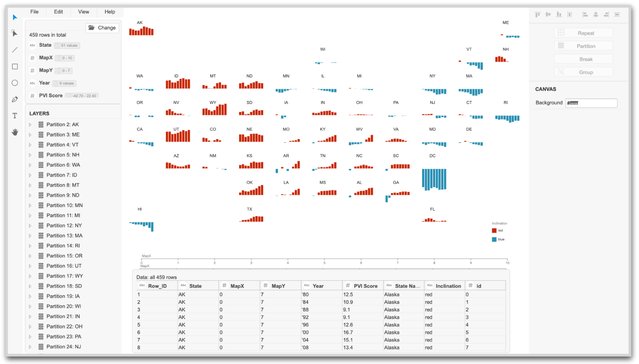


Charticulator

Auto-Generate

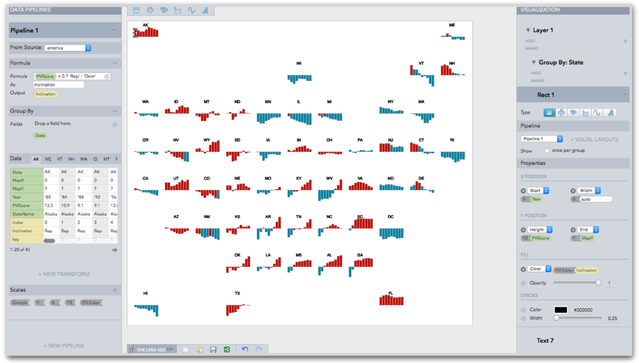
Group-By / Format





Data Illustrator

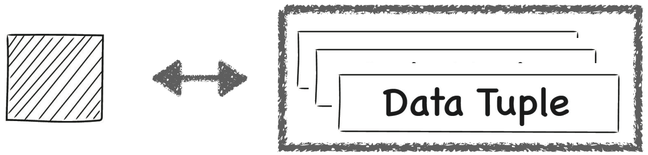
Data Binding

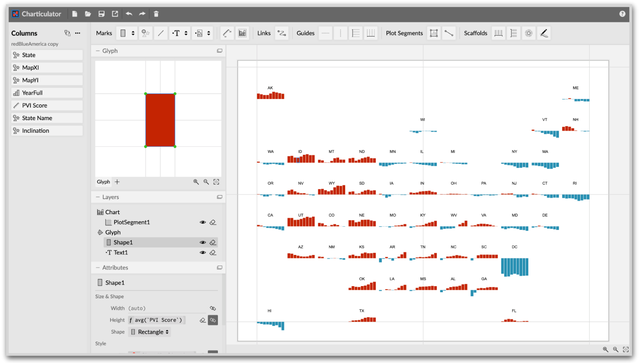


Lyra

Auto-Generate

Group-By / Format

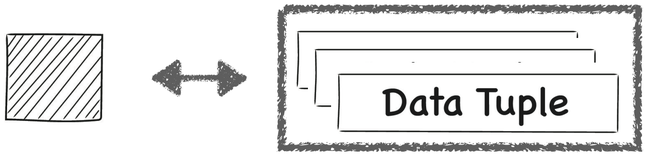


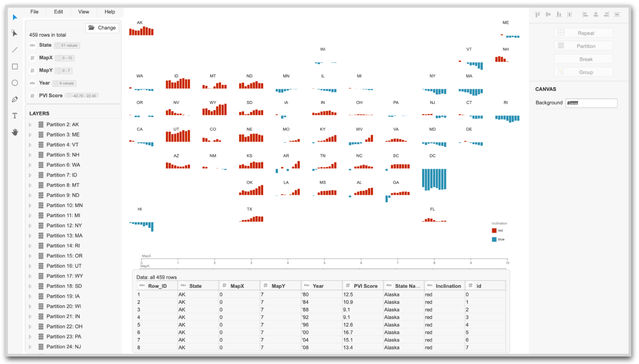


Charticulator

Auto-Generate

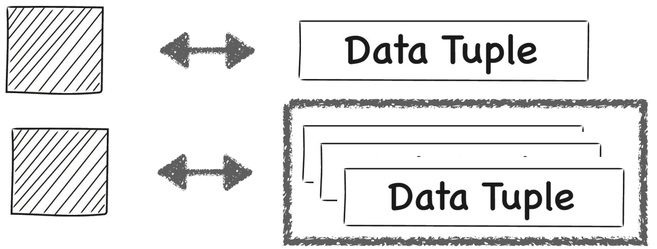
Group-By / Format



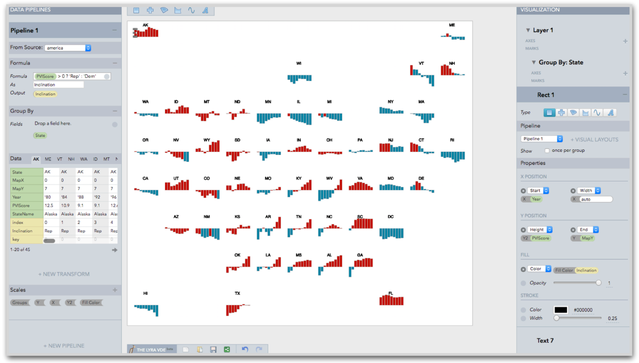


Data Illustrator

Repeat / Partition

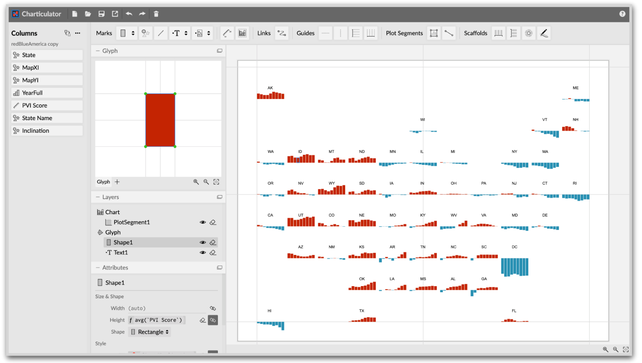


Data Binding



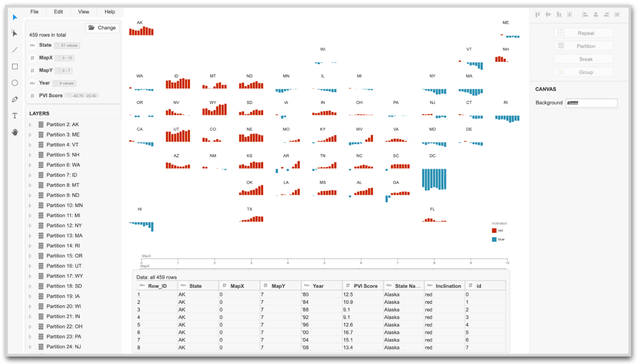
Lyra

- 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



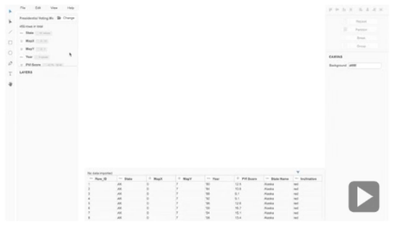
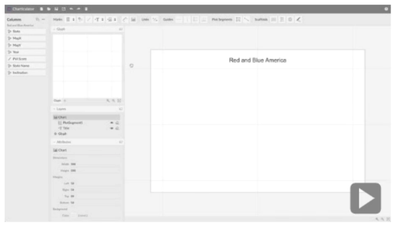
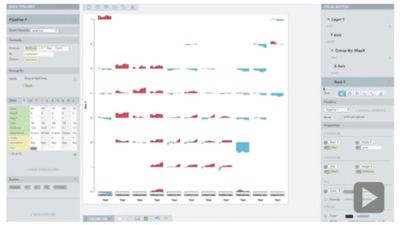
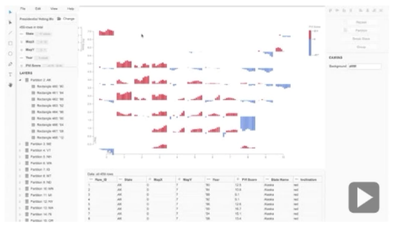
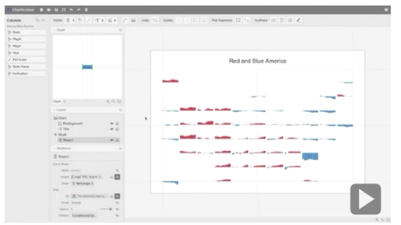
Data Illustrator

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

https://vis-tools-reflections.github.io/

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.

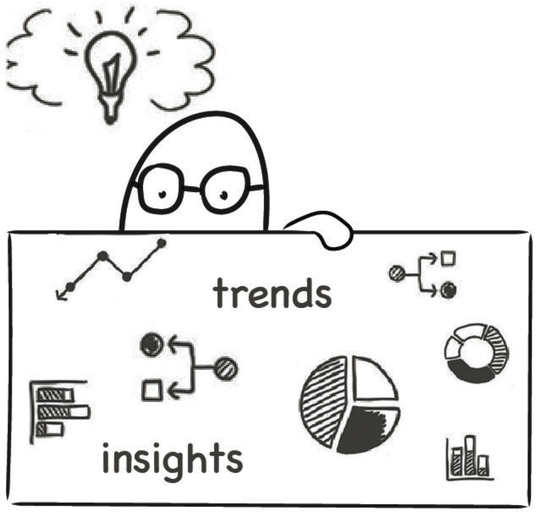
	Lyra	Data Illustrator	Charticulator
Mark Instantiation & Customization	W predefined marks only H drag from toolbar 	W custom vector shapes H draw with Pen Tool; manipulate path points & segments using Direct Selection Tool 	W predefined marks only H drag from toolbar; draw in glyph editor 
Glyph Composition	H create layers 	H group marks 	H compose in glyph editor 
Instantiation of Path Points & Path Segments	H map data values to point x, y positions	H partition line marks; draw with Pen tool	H connect glyphs using the Linking tool
Links between Glyphs	H add a force-directed layout transform	not supported	H connect glyphs using the Linking tool
Data Scoping for Glyphs	W one or more tuples per glyph H no user action needed for one tuple per glyph; “group by” for multiple tuples per glyph	W one or more tuples per glyph H repeat or partition	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.

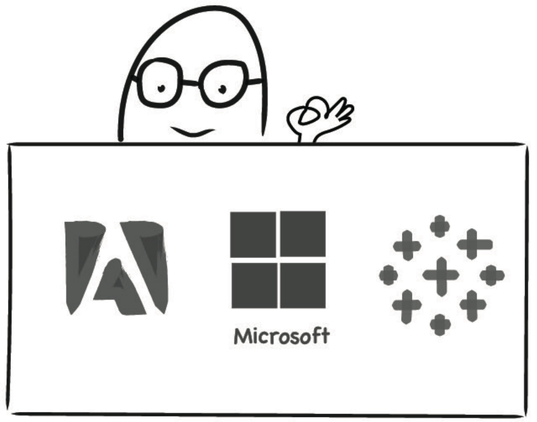
Assumptions



the user

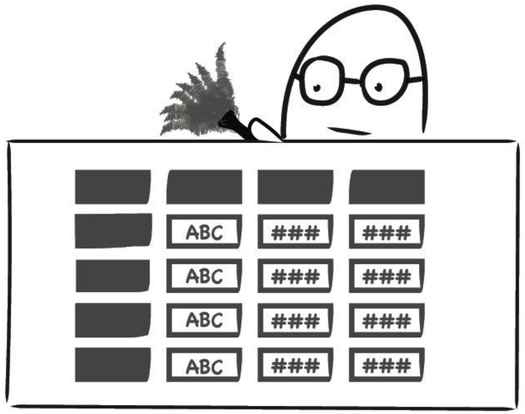
data literacy

familiar tool experience



Illustrations Inspired by: Susie Lu (@datatovis)

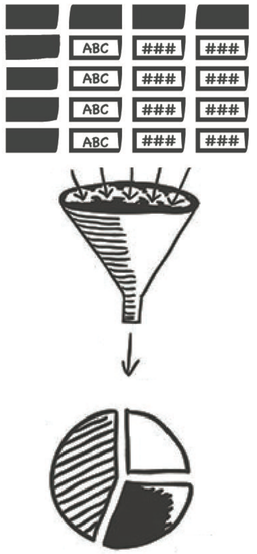
Assumptions



the data

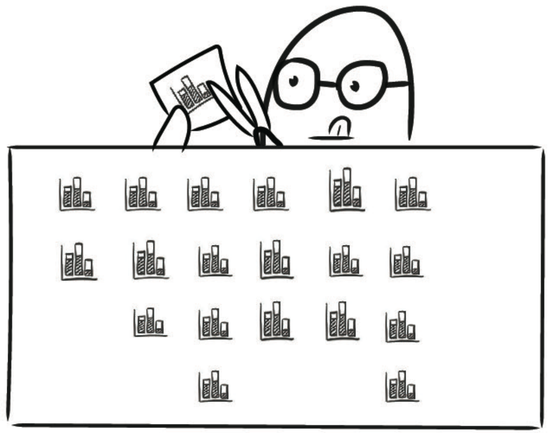
cleaned & pre-processed

"schematic congruency"



Illustrations Inspired by: Susie Lu (@datatovis)

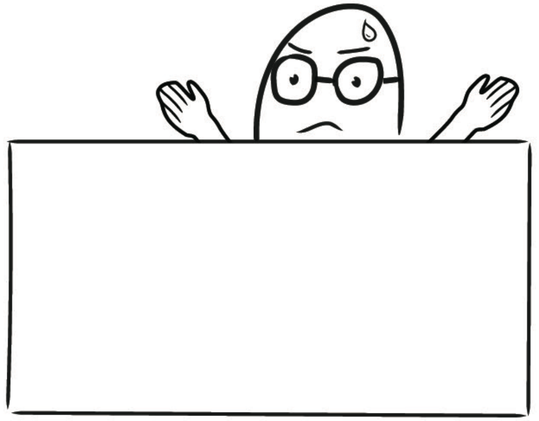
Assumptions



the task

authoring, not designing

blank canvas dilemma



Illustrations Inspired by: Susie Lu (@datatovis)

Reflecting on Critical Reflections

Critical reflection as an *evaluation method*

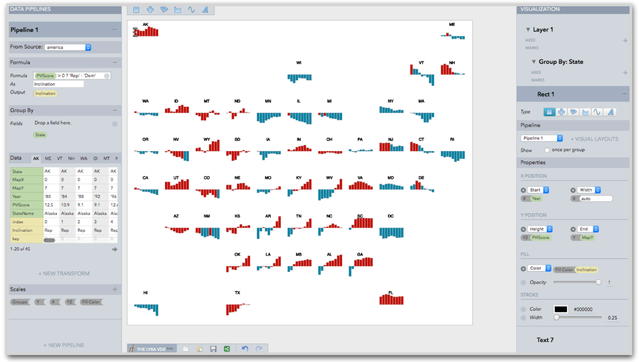
Contribute *in-depth comparisons* of our systems

Acknowledge *original assumptions* as future research directions

Thank You

vis-tools-reflections.github.io/

Lyra

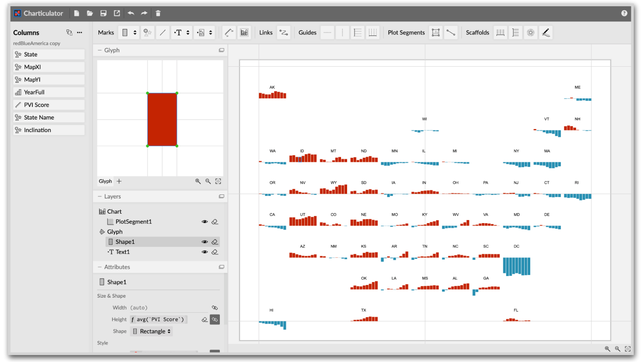


idl.cs.washington.edu/projects/lyra/

Data Illustrator

data-illustrator.com

Charticulator



charticulator.com/