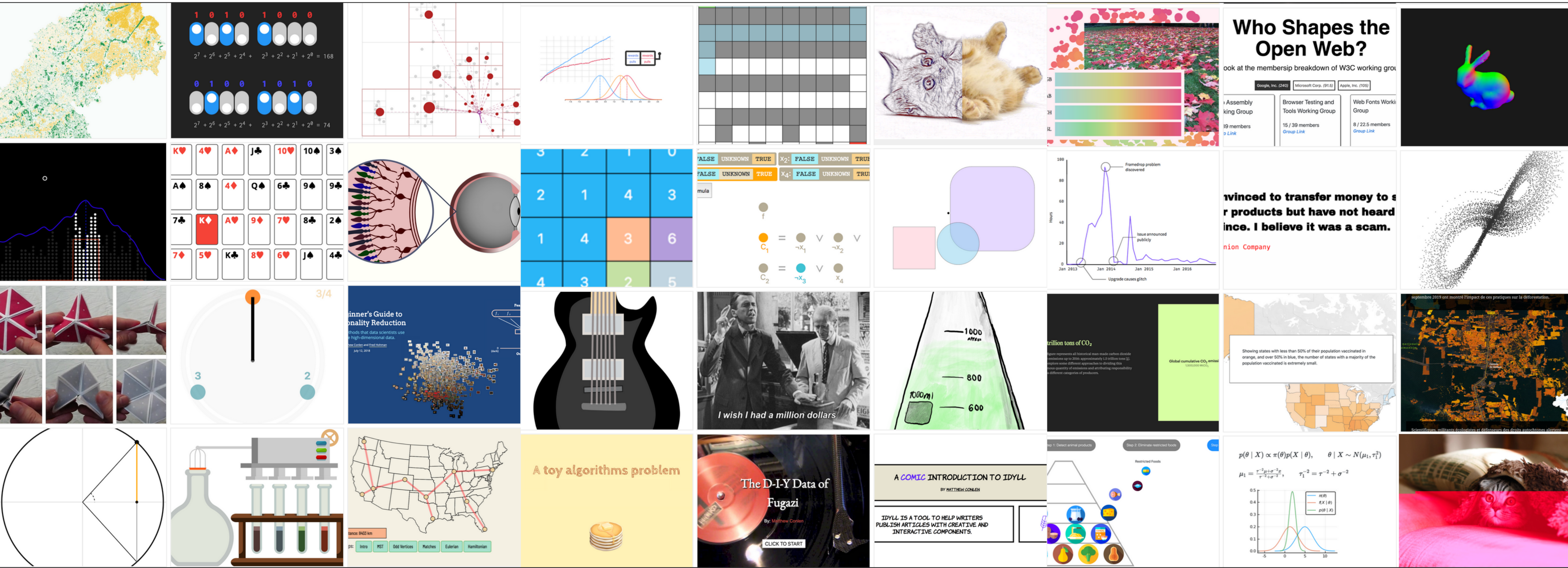


Narrative Visualization



Matthew Conlen

(with material from Jeff Heer, Edward Segel, and Jessica Hullman)

About Me

Ph.D. from UW computer science in 2021
Advised by Jeff Heer

Work as a data journalist
past: FiveThirtyEight, CNN, New Yorker,
current: New York Times

Lecture will be biased toward data journalism but the
material is more generally relevant (education, scientific
publishing, policymaking).



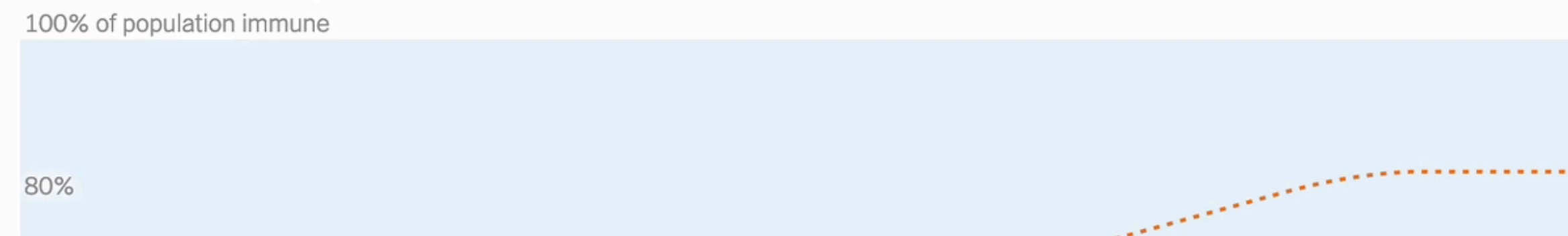
When Could the United States Reach Herd Immunity? It's Complicated.

By Matthew Conlen and Charlie Smart Feb. 20, 2021

With the [vaccine rollout](#) underway and [coronavirus cases](#) declining after a dark winter surge, it may seem as though the end of the pandemic is in sight. In reality, how soon could we get there?

One answer lies in herd immunity, the point when enough people are immune to the virus that it can no longer spread through the population. Getting there, however, depends not just on how quickly we can vaccinate but on other factors, too, like how many people have already been infected and how easily the virus spreads.

An estimate for the path to herd immunity



When Could the United States Reach Herd Immunity? It's Complicated.

Conlen & Smart, New York Times 2021

Motivation

Transparency in journalism

“A sense of the tentativeness of truth.”

- Philip Meyer, *Precision Journalism*, 2002

More engaged audience

Greussing & Boomgaarden, *Digital Journalism* 2019

Better learning outcomes

Mayer's *Multimedia Principles*, 2005

Promote active reading

Victor's "Explorable Explanations", 2011

...also many challenges!

The screenshot shows a New York Times article from February 20, 2021, by Matthew Conlen and Charlie Smart. The article discusses the path to herd immunity for COVID-19. It features a line chart titled "An estimate for the path to herd immunity" which plots the percentage of the population immune over time from December 2020 to December 2021. The chart shows two lines: a solid orange line for "Total immunity" and a dashed red line for "Fully vaccinated". A blue shaded area at the top of the chart, between 70% and 90% immunity, is labeled "Herd immunity range". The "Total immunity" line crosses this range in late March 2021. The text explains that reaching herd immunity is complicated because it depends on factors like vaccination rates, infection rates, and how long immunity lasts. It also notes that in most scenarios, millions more people will become infected and tens or hundreds of thousands more will die before herd immunity is reached. A section titled "What if we speed up vaccinations?" suggests that doubling the current vaccination rate could reach the herd immunity threshold faster.

When Could the United States Reach Herd Immunity? It's Complicated.

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An estimate for the path to herd immunity

100% of population immune

80%
60%
40%
20%

Herd immunity range

Total immunity

Fully vaccinated

Dec. Jan. 2021 Feb. March April May June July Aug. Sept. Oct. Nov. Dec.

This chart shows the current path to herd immunity in the United States, based on a model developed by [PHICOR](#), a public health research group. It looks at the number of people who have been **fully vaccinated** and combines that with an estimate of the number of people who have been infected and have recovered to measure **total immunity**.

When the orange line crosses into the blue area, that means we have entered the **herd immunity range**. The exact threshold for herd immunity for the coronavirus is unknown, but recent estimates range from 70 percent to 90 percent.

At first, this looks like pretty good news — under these assumptions, we could reach herd immunity as early as July. But a lot could happen between now and then. The speed and uptake of vaccination, and how long immunity lasts are big factors. The rise of new virus variants and how we respond to them will also affect the path to herd immunity.

In most scenarios, millions more people will become infected and tens or hundreds of thousands more will die before herd immunity is reached.

What if we speed up vaccinations?

More than 15 million people have been fully vaccinated, and the U.S. is currently administering about 1.7 million shots per day. Some experts say we could nearly [double that pace](#) by April as new vaccines are approved. (Because the current vaccines require two doses spaced weeks apart, the number of people fully vaccinated each day is smaller.)

The more people we vaccinate, the faster we could reach the threshold for herd immunity.

CHOOSE A SCENARIO

Topics

Storytelling

- How different mediums can be used to tell stories

Design of narrative visualizations & interactive articles

- Segel & Heer, 2010
- Hohman, et al 2020

Research on Authoring Tools

- Idyll, *UIST 2018*
- Idyll Studio, *UIST 2021*

Design exercise

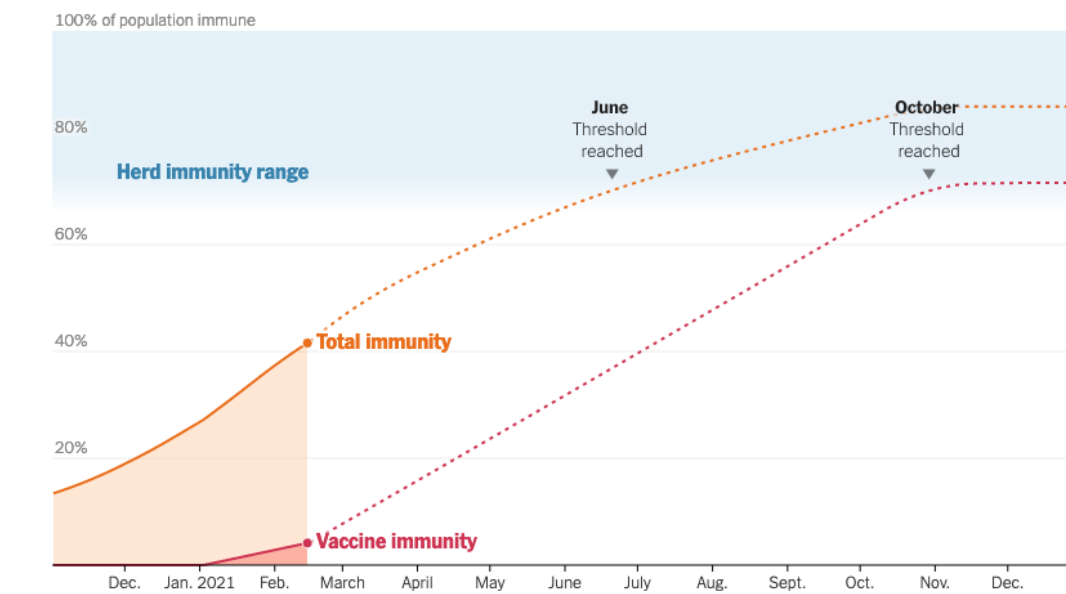
- Prompt similar to real-world task you'd see as a data journalist

While this means we would reach herd immunity sooner because more people would get sick and develop antibodies, that speed would come at a grim cost.

CHOOSE A SCENARIO

Keep measures in place Continue social distancing until most people are vaccinated.	Ease up in the spring Lift restrictions when 15 percent of people are vaccinated.	End precautions now Lift restrictions when few people are vaccinated.
---	---	---

If we end restrictions in April, we could reach the herd immunity threshold by **June**. But in that time, **170,000** people could die from the virus.



Precautions remain especially important as new variants of the virus emerge. If social distancing measures aren't followed, a stronger virus could rapidly infect and kill hundreds of thousands of people before they can be vaccinated.

What if a more contagious variant spreads?

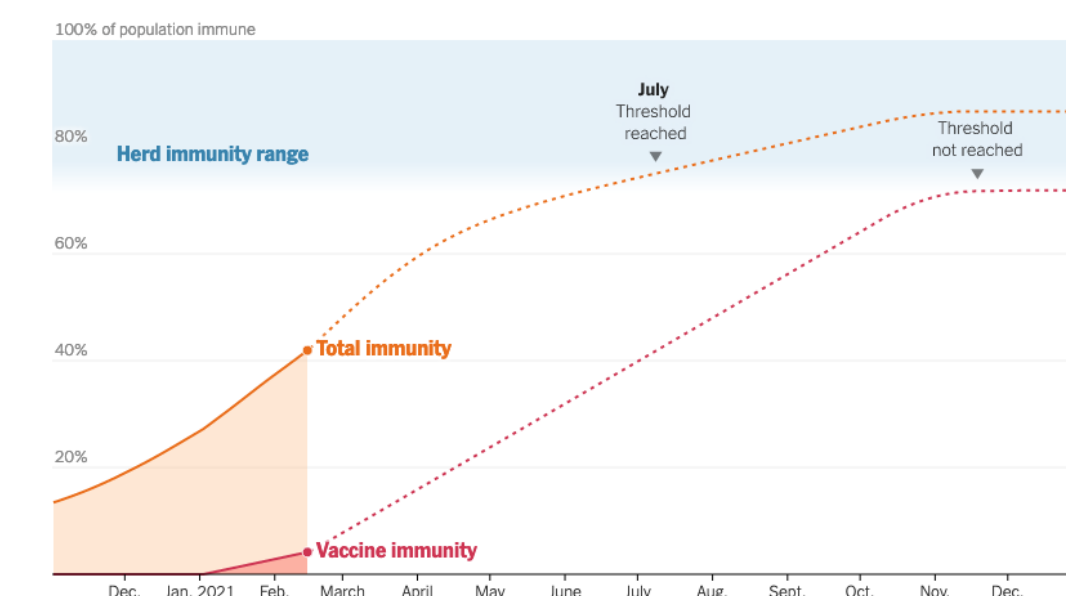
A more contagious variant of the virus, like the one first identified in Britain that is now [spreading](#) throughout the United States, could further complicate the path to herd immunity.

If the virus becomes more contagious, the threshold for herd immunity will go up. It may be hard for vaccines to keep pace, and precautions will be even more necessary to stem the spread.

CHOOSE A SCENARIO

Current variant with precautions Transmissibility and precautions remain the same.	More contagious variant with precautions Transmissibility increases but preventative measures continue.	More contagious variant with no precautions Preventative measures end in March and transmissibility increases.
--	---	--

A more contagious variant will spread faster and raise the herd immunity threshold. We could still expect to reach herd immunity in **July**, but new deaths could double, to **200,000** people.

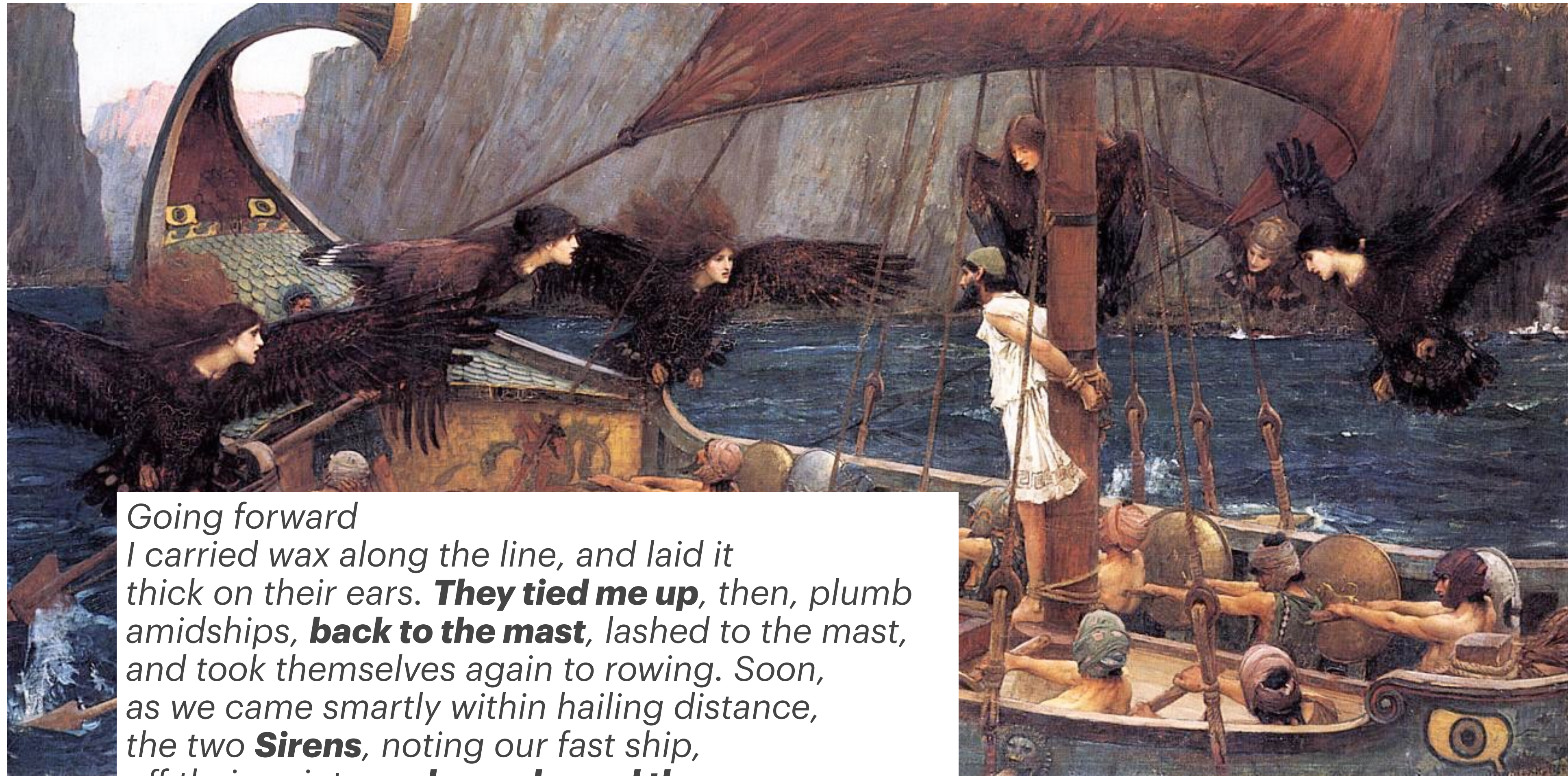


The spread of new virus variants makes it impossible to put a firm date on when we'll reach herd immunity or when the pandemic will end. There's a chance a mutation could lead to a version of the virus that doesn't respond to existing immunity, leading us to start the journey to herd immunity all over again.

Dr. Lee said that coronaviruses have relatively high mutation rates and that it is likely that new variants of the virus will continue to emerge. "The question will be how different might these variants be," he said. If a variant of the virus stops responding to the

STORYTELLING

as ancient as mankind



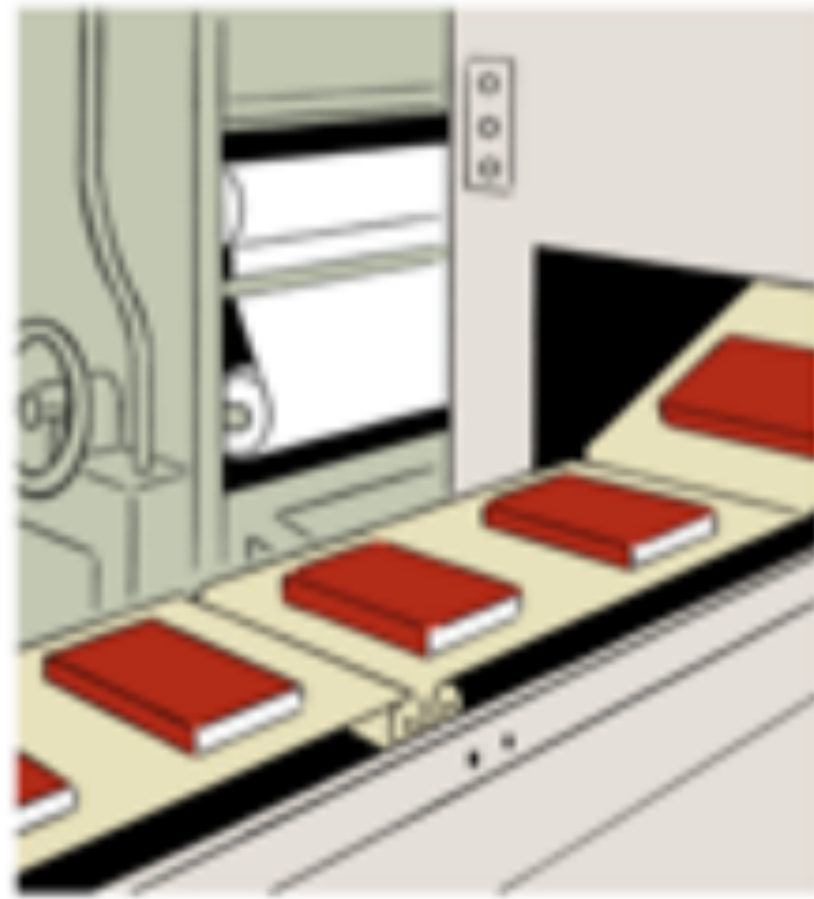
Going forward
I carried wax along the line, and laid it
thick on their ears. **They tied me up**, then, plumb
amidships, **back to the mast**, lashed to the mast,
and took themselves again to rowing. Soon,
as we came smartly within hailing distance,
the two **Sirens**, noting our fast ship,
off their point, **made ready, and they sang...**

Narrative Storytelling

narrative (n): An account of a series of events, facts, etc., given in order and with the establishing of connections between them.

Effective storytelling “require[s] skills like those familiar to movie directors, beyond a technical expert’s knowledge of computer engineering and science.” - Gershon & Page ‘01







Justice Stephen G. Breyer to Retire From Supreme Court



Justice Stephen G. Breyer was appointed to the Supreme Court in 1994 by President

WASHINGTON — Justice Stephen G. Breyer, the senior member of the Supreme Court's three-member liberal wing, will retire, two people familiar with the decision said, providing President Biden a chance to make good on his campaign pledge to name a Black woman to the court.

Mr. Biden is expected to formally announce the retirement at the White House on Thursday, according to one person familiar with the planning for the event.

Justice Breyer, 83, the oldest member of the court, was appointed in 1994 by President Bill Clinton. After [the death of Justice Ruth Bader Ginsburg in 2020](#) and [the appointment of Justice Amy Coney Barrett](#) by President Donald J. Trump, he became the subject of an energetic campaign by liberals who wanted him to step down to ensure that Mr. Biden could name his successor while Democrats control the Senate.

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Lede
(lead paragraph)

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**Nut Graf
(nutshell paragraph)**

STORYTELLING

across various media

PEOPLE TELL STORIES

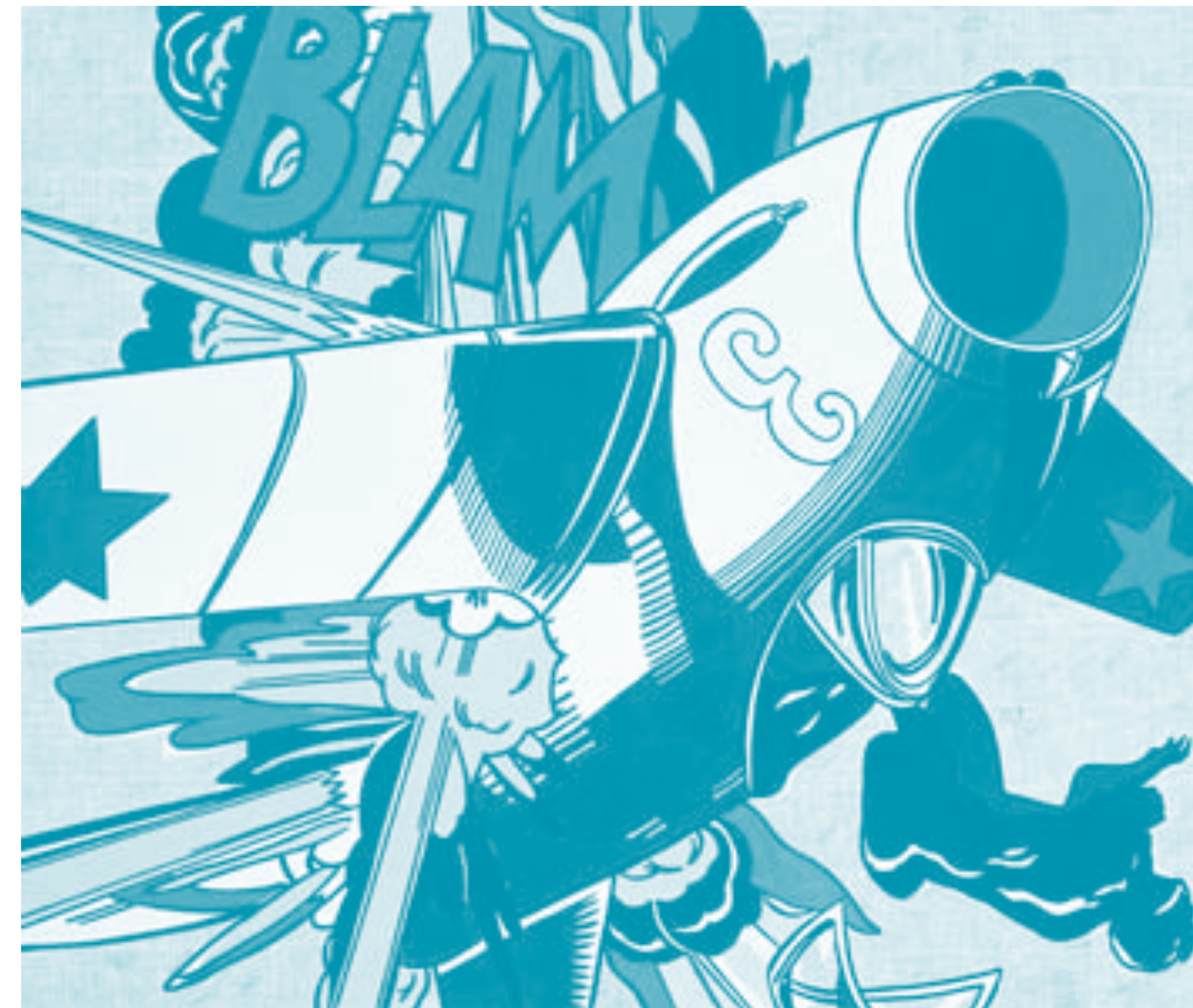
WORDS TELL STORIES

IMAGES TELL STORIES

COMICS TELL STORIES

MOVIES TELL STORIES

DATA TELLS STORIES?





Privacy and the internet

Lives of others

BY ANDREW HARRIS

Facebook and Google face a backlash from users and regulators alike over the way they have handled sensitive data

JENNIFER STUCKOMT, Canada's privacy commissioner, negotiates with Facebook in August 2010, the social networking site stands a deal, agreeing to change its policies within a year to comply with the country's privacy law. Next year, Ms Stuckomt, the commissioner, appears to be sending an important part of the deal, which included giving users a clear and easy-to-implement choice over whether to share private data with third parties. "I don't seem to see that Facebook is going in the right direction on this issue," she says. "Hiring him, without a change of course, the firm could soon become the subject of another formal investigation by her organisation."

Facebook is not the only internet giant to provoke the ire of data watchdogs. Google ended software updates this week following news that it had accessed some personal communications sent over unsecured Wi-Fi data networks in homes and offices by some 30 countries. On May 21st Peter Schaar, Germany's federal commissioner for data protection, called for an independent investigation into Google's behavior, claiming that it had "deeply disrupted normal rules in the development and usage of software."

The cases highlight rising tension between guardians of privacy and internet firms. And they reflect concerns among web users about how private data are made public. Several prominent internet

ty pioneers like Cory Doctorow, a science-fiction author, and Ian Japane, a politician, have abandoned Facebook. Sites such as the anti-Facebook blog are warning others to do the same, including May 21st for another Facebook "boycott".

There is an effort to stop the momentum of Facebook, which is poised to claim half a billion members and which draws over seven million as a whole to its site (see chart). But news has been leaked of the company's heady ascent in Silicon Valley, where bosses are exuding over how to respond. Several senior folk are now hinting that Facebook will soon roll out stricter privacy controls to make it easier to keep more data hidden. MySpace, a rival, is already making its controls stricter in an effort to woo disaffected Facebookers to its service.

A rival over Facebook's handling of privacy has been hovering for some time. In December the social network changed the default settings on its privacy controls so that individuals' personal information would be shared with "everyone" rather than selected friends. Facebook argued this reflected a shift in society towards greater openness and noted that users could still adjust privacy settings back again. But increased privacy activism lobbied for it to be reversed.

The switch should not have come as a surprise. Early on, many social networks

Also in this section

- 68 Spring conspiracies
- 69 The recovery of General Motors
- 69 Business crime in China
- 70 Indian retail
- 70 Japan's drug firms on the move
- 71 Brazil's talacoma
- 71 Schumpeter: Overstretched

See July analysis and feature on business, www.economist.com/business-features

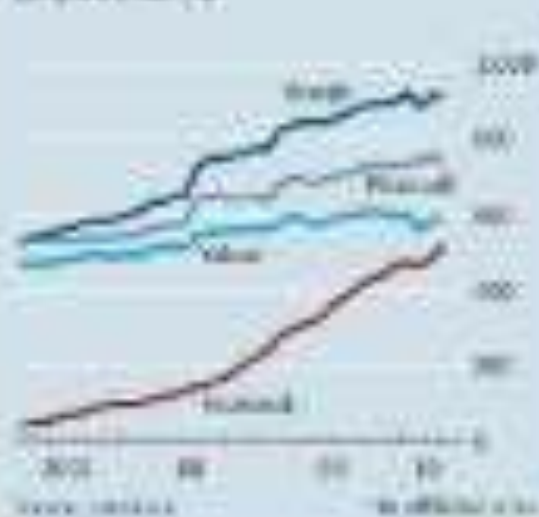
trapped itself to tight privacy policies in order to attract and retain users. But as more jobs, controls are gradually loosened to encourage more sharing. As people share more, Facebook can increase the traffic against which it sells advertising. And the more it knows about users' likes and dislikes, the better it can target ads that generate hundreds of millions of dollars.

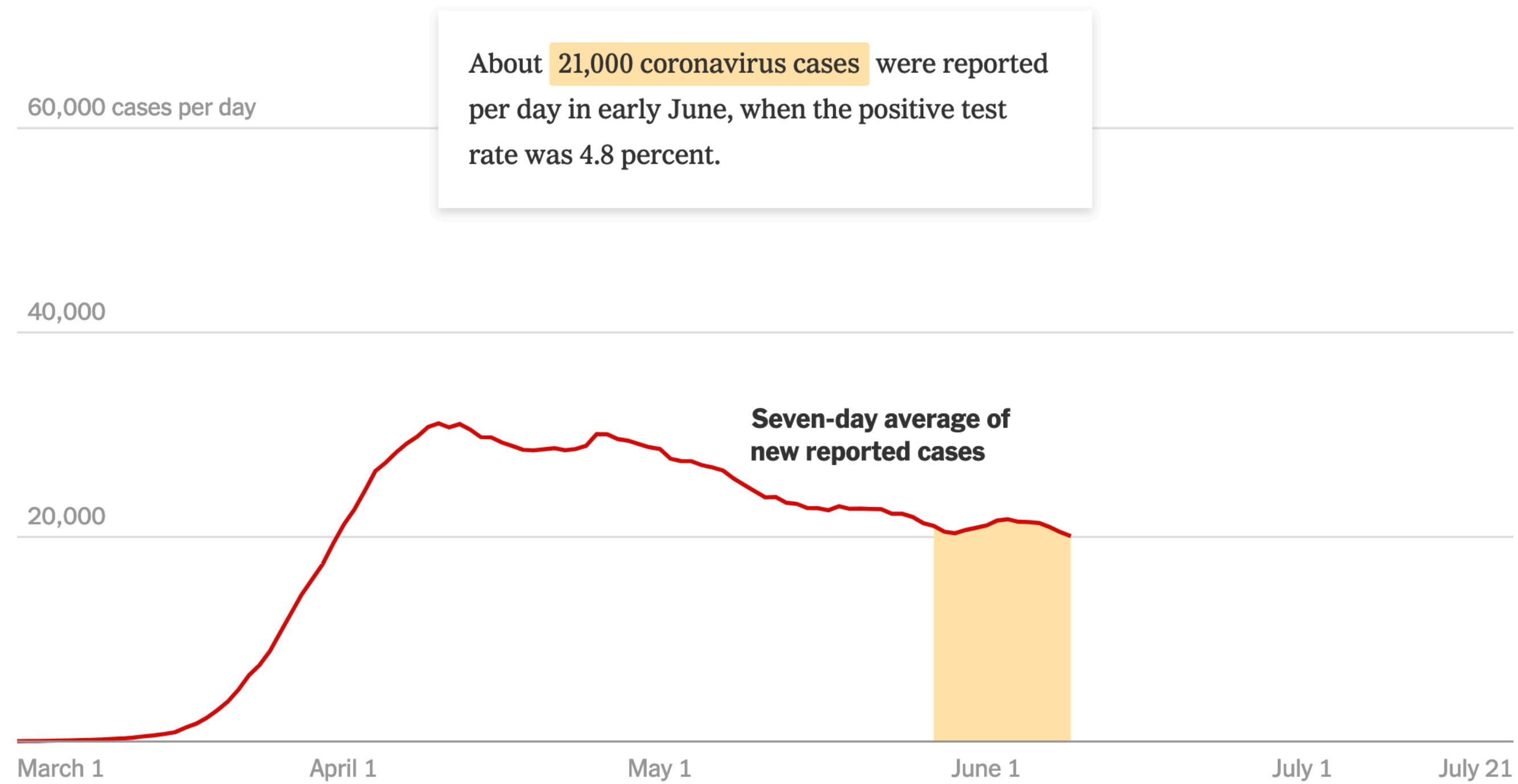
Privacy goes further still following a developers' conference last month at which Mark Zuckerberg, Facebook's boss, announced yet another series of policy changes. One that raised attention was an "extended personalisation" feature that lets create third-party websites access Facebook data about people who visit. Critics say that Facebook has made it risky to delete this feature, which may explain why its Standard Settings have been

European critics are grumbling about Facebook too. This month a group of data-protection experts who advise the European Commission wrote to the social network, calling its decision to loosen the default settings "unacceptable". And in the US

Not letting face

Facebook's growth





CASE STUDY COVID-19 TESTING
Conlen, 2020

CASE STUDY COVID-19 TESTING

Input Data

Daily case and test counts.

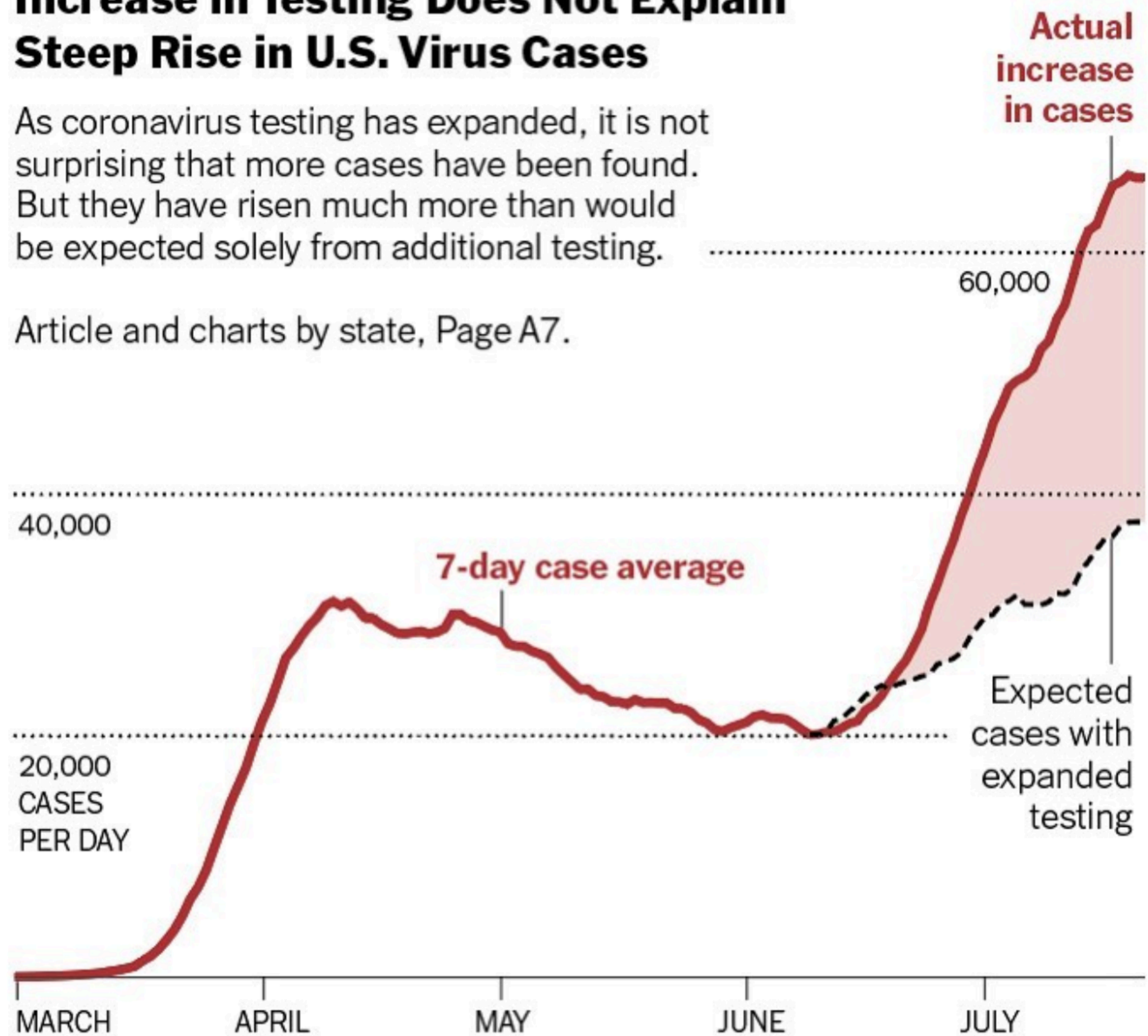
Points of Focus

1. Baseline (smoothed average of daily cases)
2. Counterfactual case curve
(baseline positivity rate * daily test counts),
3. Actual case curve (daily cases)

Increase in Testing Does Not Explain Steep Rise in U.S. Virus Cases

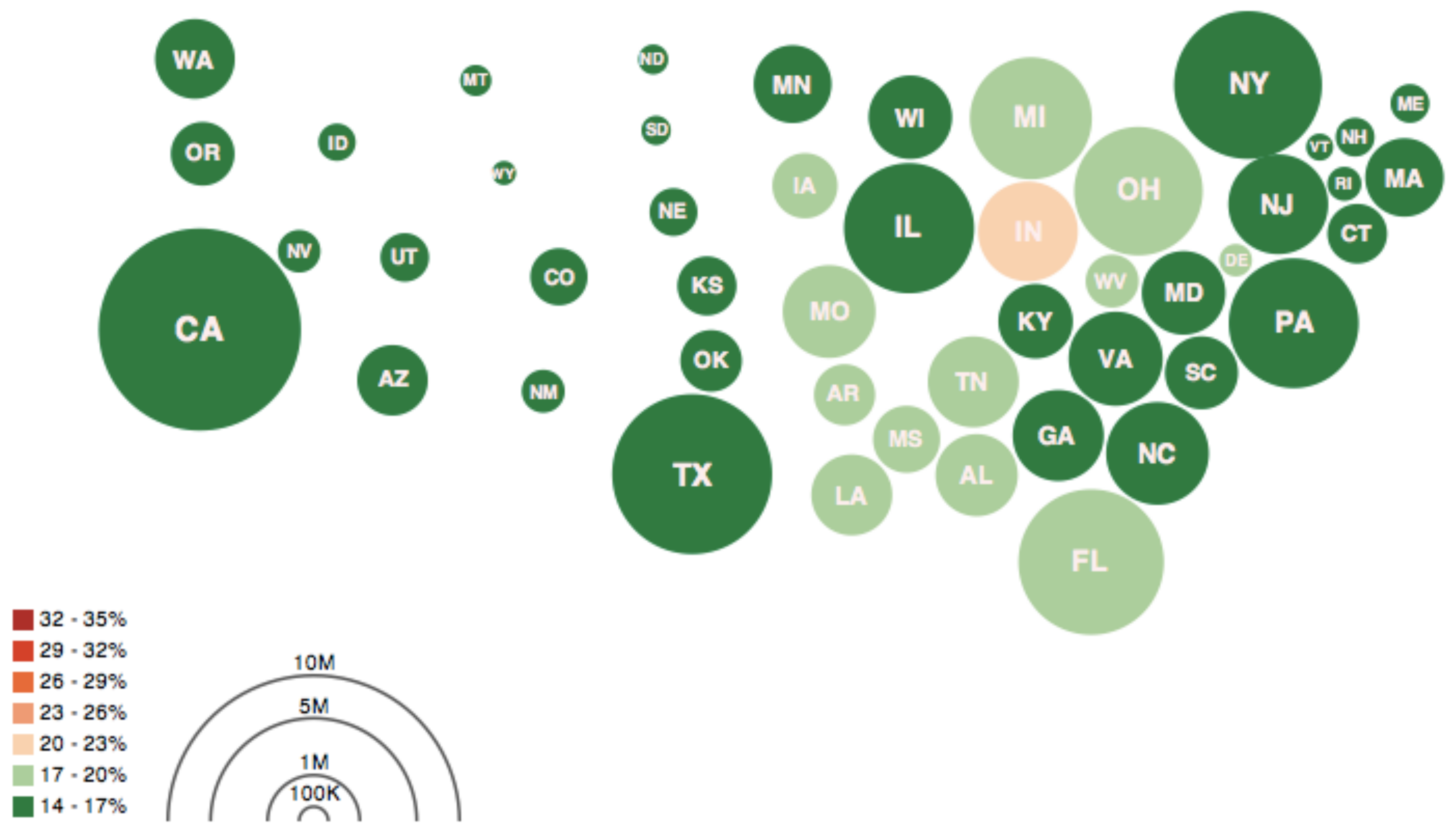
As coronavirus testing has expanded, it is not surprising that more cases have been found. But they have risen much more than would be expected solely from additional testing.

Article and charts by state, Page A7.

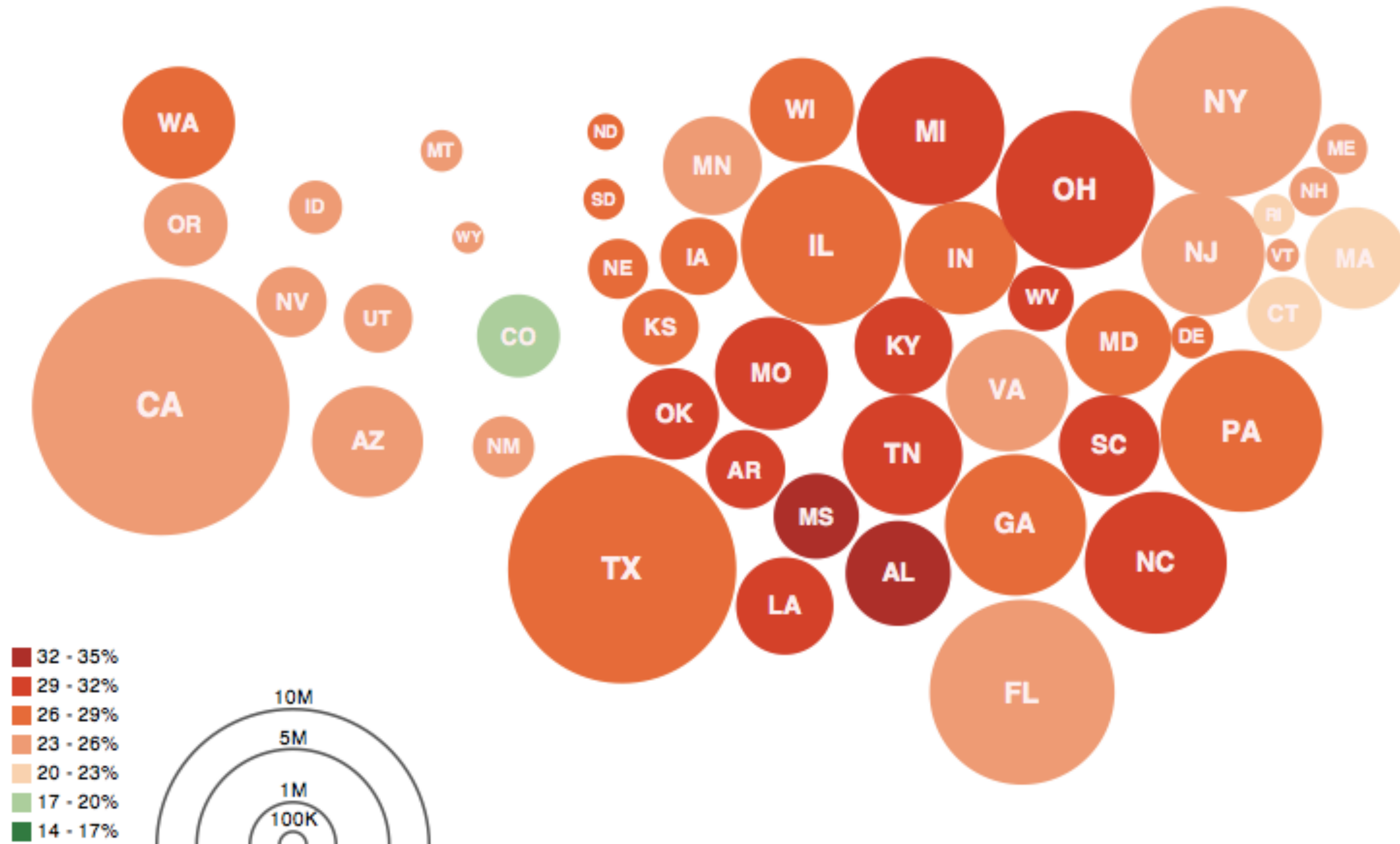


Source: The COVID Tracking Project

MATTHEW CONLEN/THE NEW YORK TIMES



Obesity Map Vadim Ogievetsky



Obesity Map Vadim Ogievetsky

Of the 7,666 times that police officers killed people in the U.S. between 2013 and 2019...

25 (0.3%) resulted in a conviction



74 (1.0%) resulted in a charge but no conviction >



and...



monachalabi • Follow

United States



monachalabi Total disbelief about the system doing the bare minimum. George Floyd deserved so much more than this, he deserved to live.

Some detail about those 25 sentences:

Unknown sentence = 4 police killings

Just probation = 3

3 months in jail = 1

1 year in jail, 3 years suspended = 1

1 year in prison = 1

18 months in prison = 1

2.5 years in prison = 1

4 years in prison = 1

5 years in prison = 1

6 years in prison = 1

16 years in prison = 1

20 years in prison = 1

30 years in prison = 2



22,976 likes

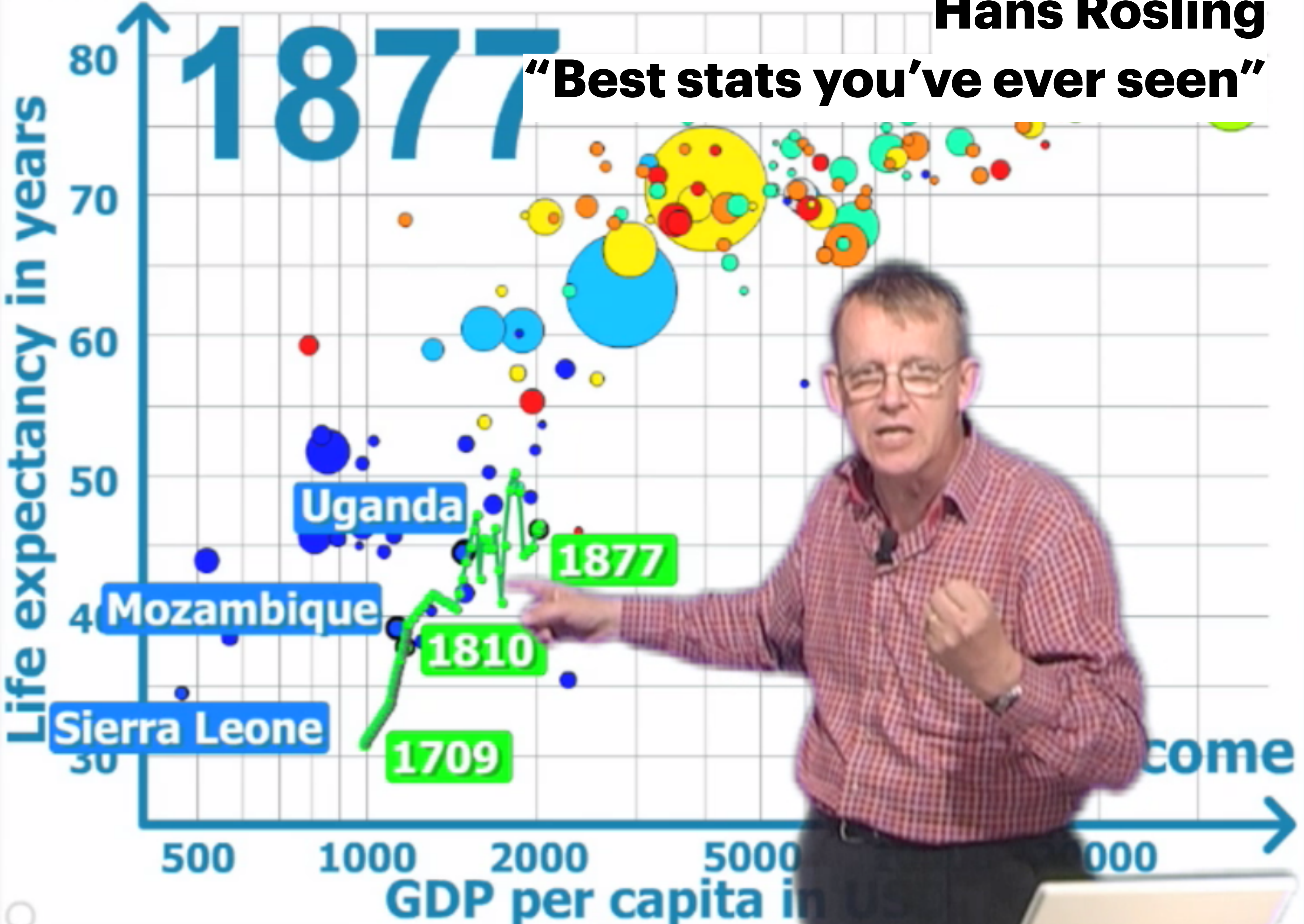
3 HOURS AGO

Log in to like or comment.

Health

Hans Rosling

"Best stats you've ever seen"



Narrative Devices

What devices communicates best?

Highly dependent on: audience, context, format

Format

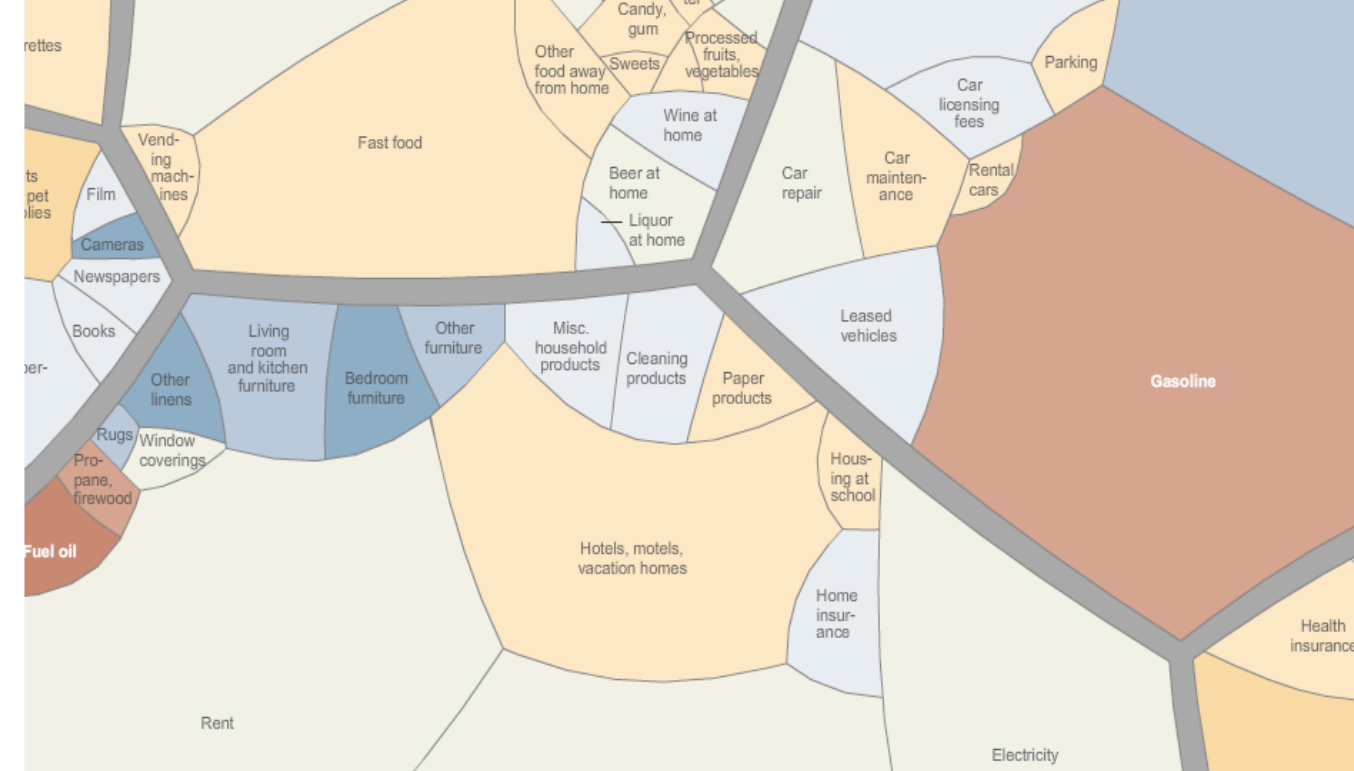
Interactive Article

Animation

Lecture

Still Image

Video

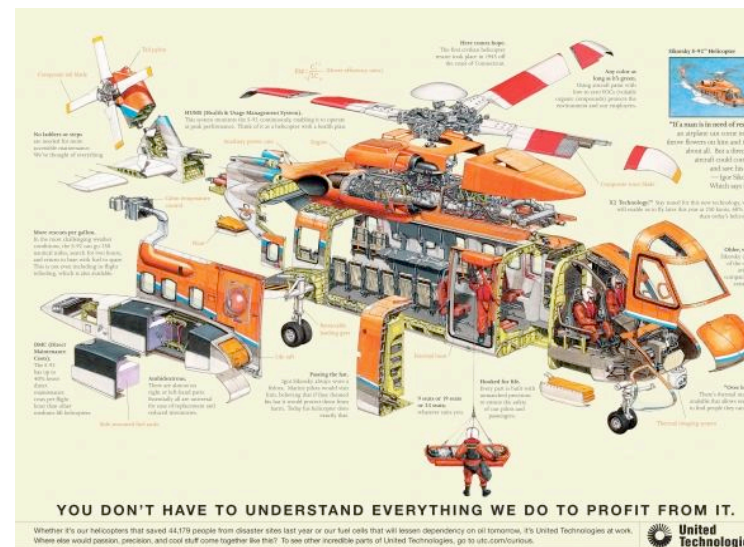
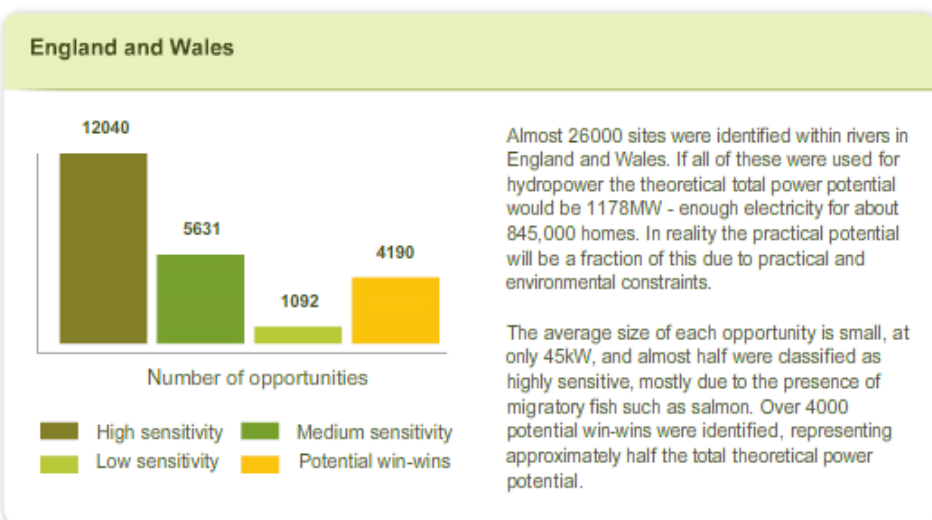
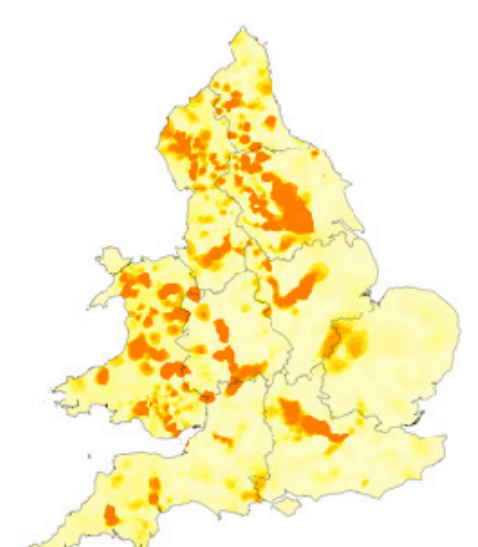
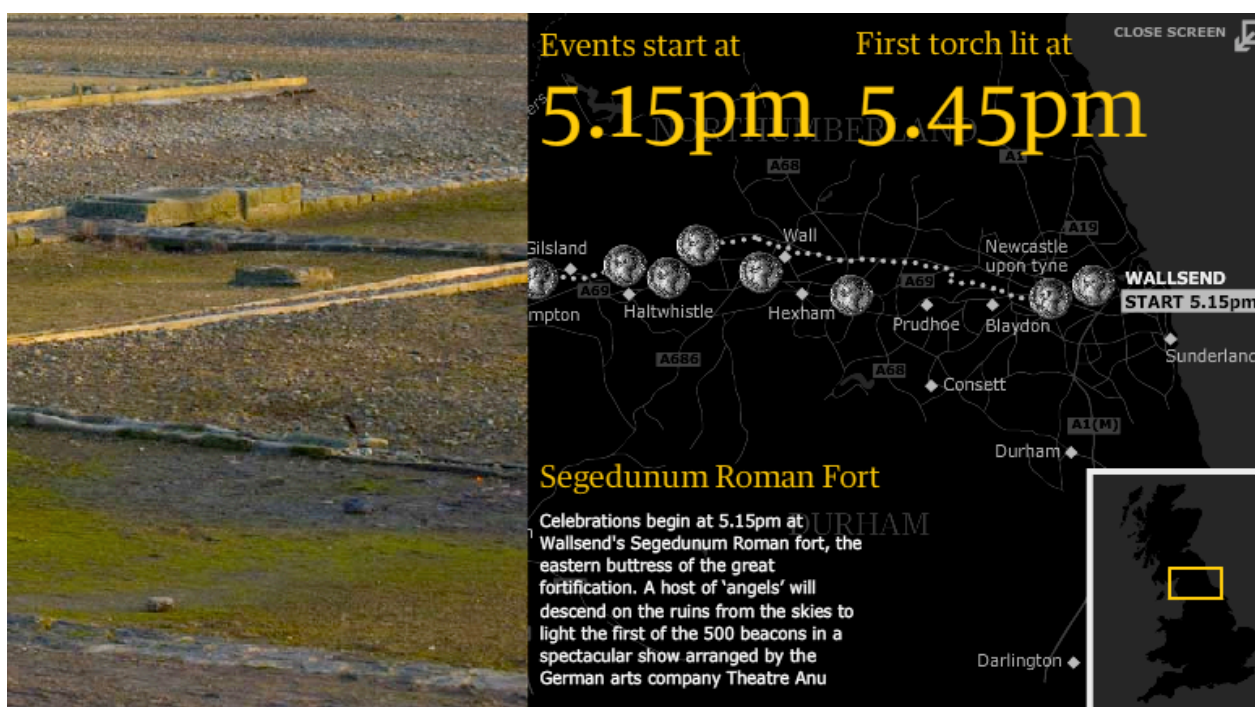
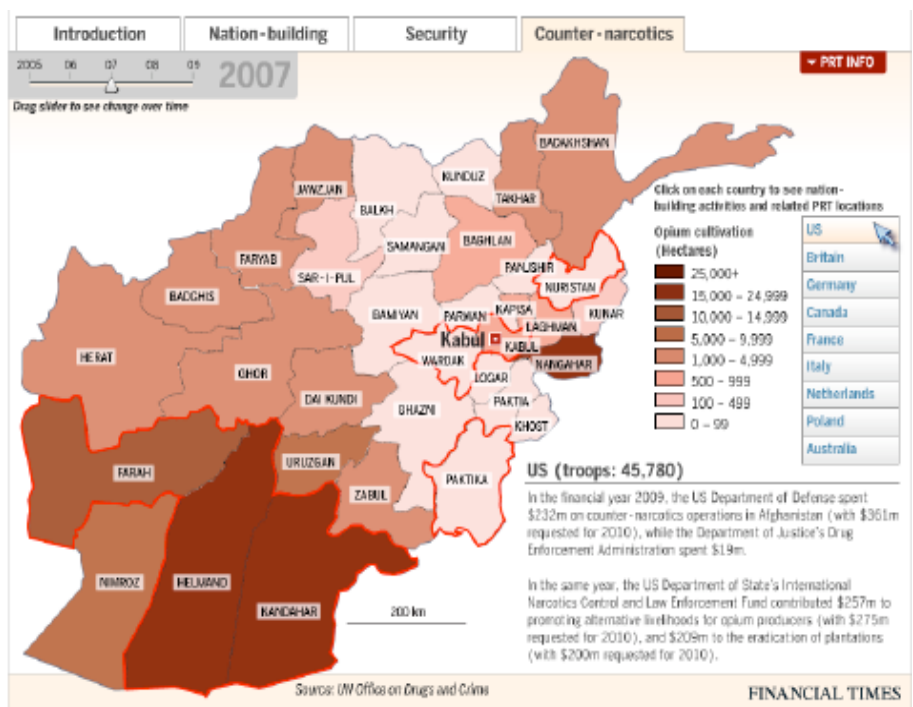
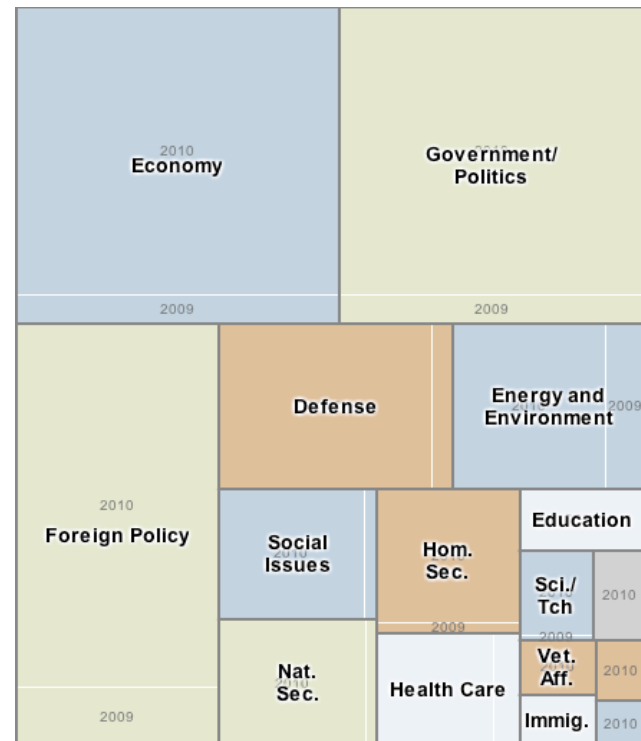


58 CASE STUDIES

70% Journalism
20% Business
10% Research



2008 Medal Count



Segel & Heer, 2010

755

Steroids or Not, the Pursuit Is On

Barry Bonds is taking aim at the career home run record. He needs only six more to tie Babe Ruth and 47 to equal Hank Aaron.



Lines are cumulative home runs.

Hank Aaron
755 homers
23 seasons

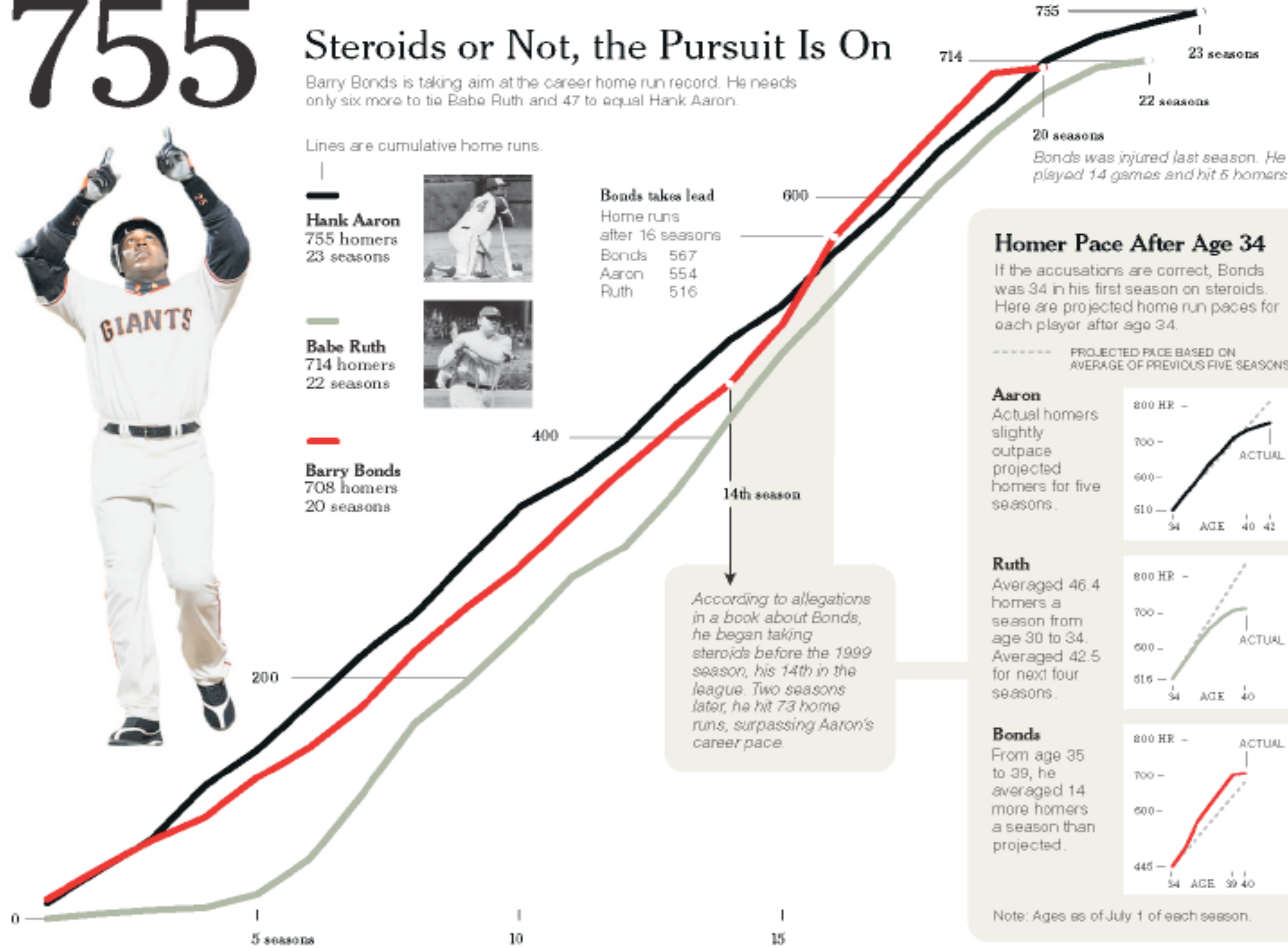


Babe Ruth
714 homers
22 seasons



Barry Bonds
708 homers
20 seasons

Bonds takes lead
Home runs
after 16 seasons
Bonds 567
Aaron 554
Ruth 516

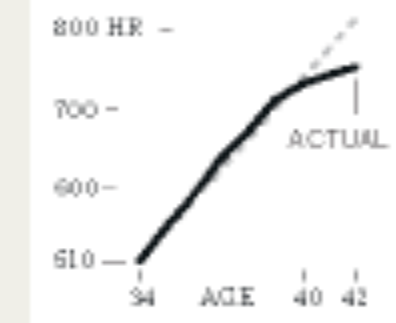


Homer Pace After Age 34

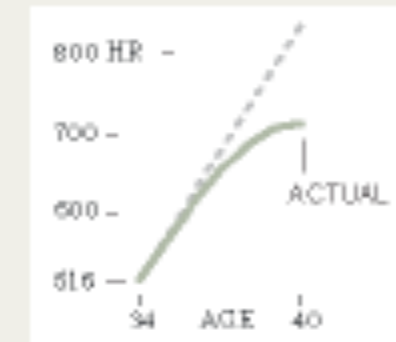
If the accusations are correct, Bonds was 34 in his first season on steroids. Here are projected home run paces for each player after age 34.

----- PROJECTED PACE BASED ON AVERAGE OF PREVIOUS FIVE SEASONS

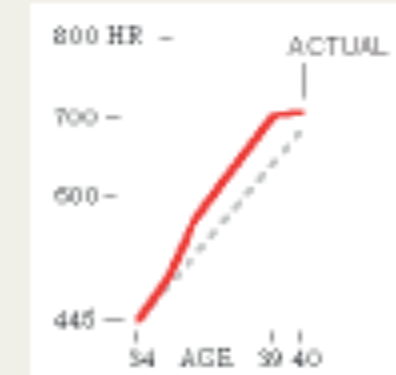
Aaron
Actual homers slightly outpace projected homers for five seasons.



Ruth
Averaged 46.4 homers a season from age 30 to 34. Averaged 42.5 for next four seasons.



Bonds
From age 35 to 39, he averaged 14 more homers a season than projected.



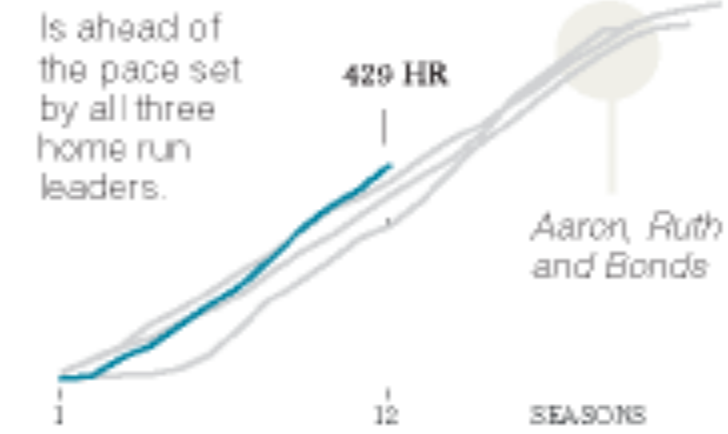
Note: Ages as of July 1 of each season.

Others Taking Aim



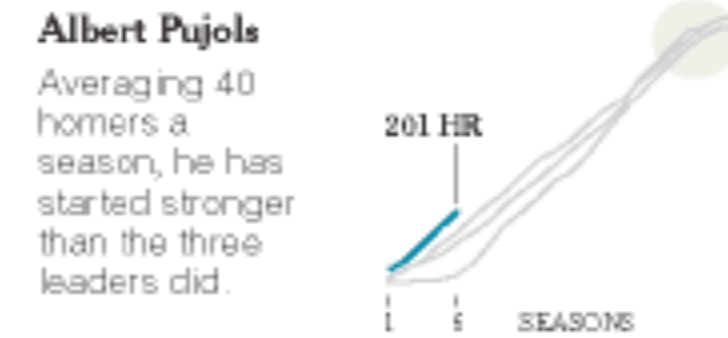
Alex Rodriguez

Is ahead of the pace set by all three home run leaders.



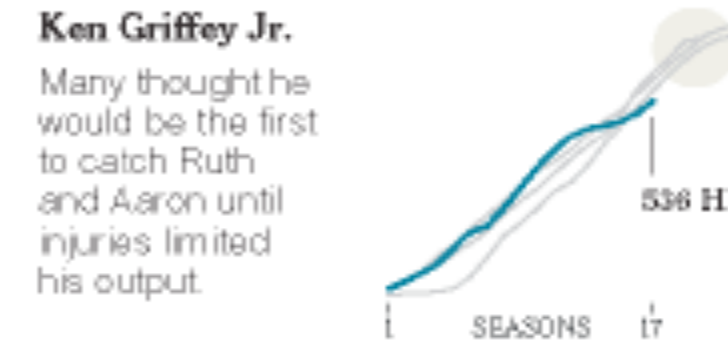
Albert Pujols

Averaging 40 homers a season, he has started stronger than the three leaders did.



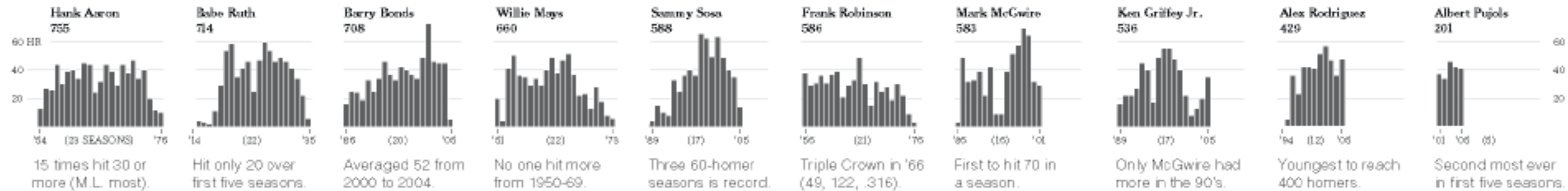
Ken Griffey Jr.

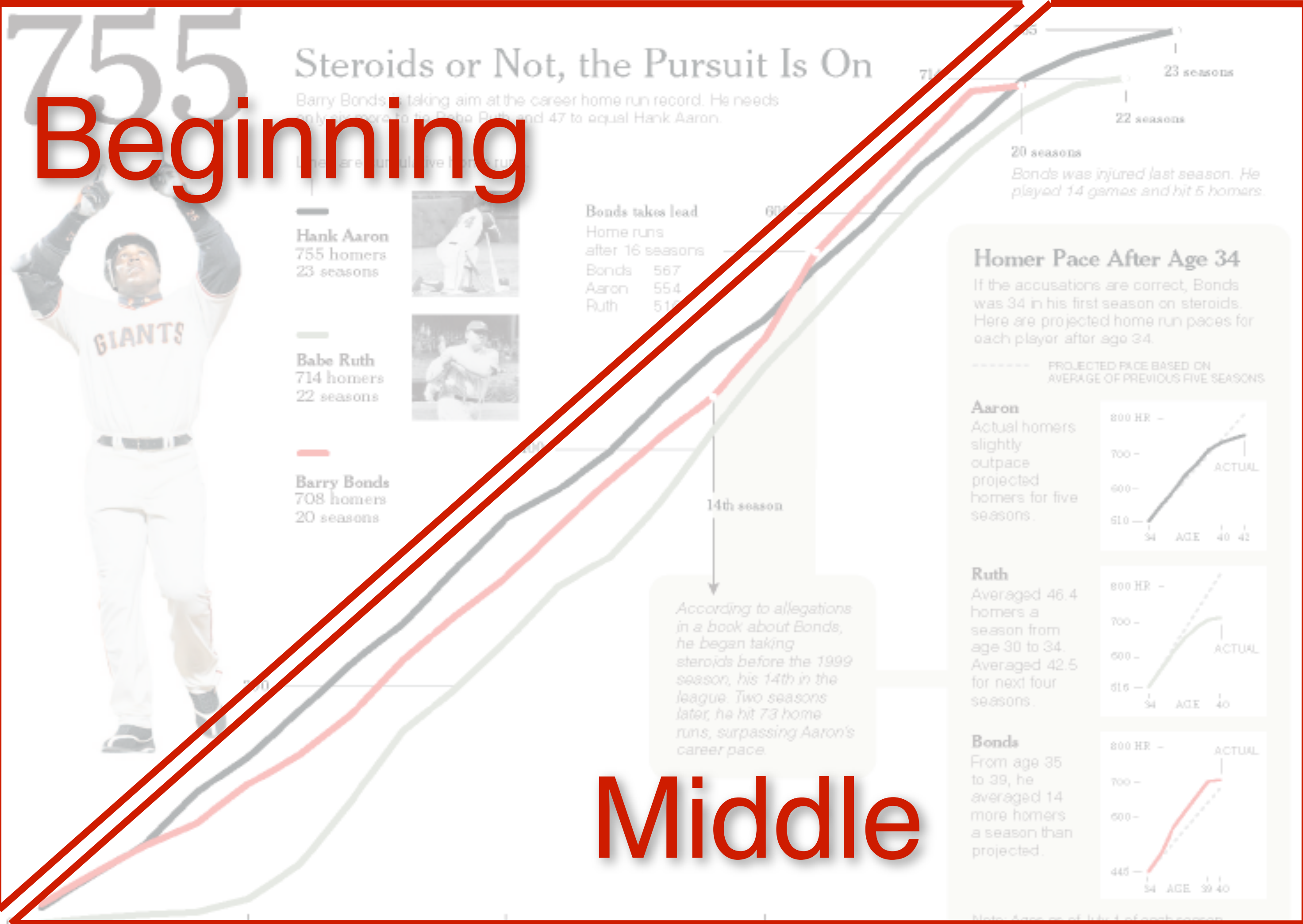
Many thought he would be the first to catch Ruth and Aaron until injuries limited his output.



Differing Paths to the Top of the Charts

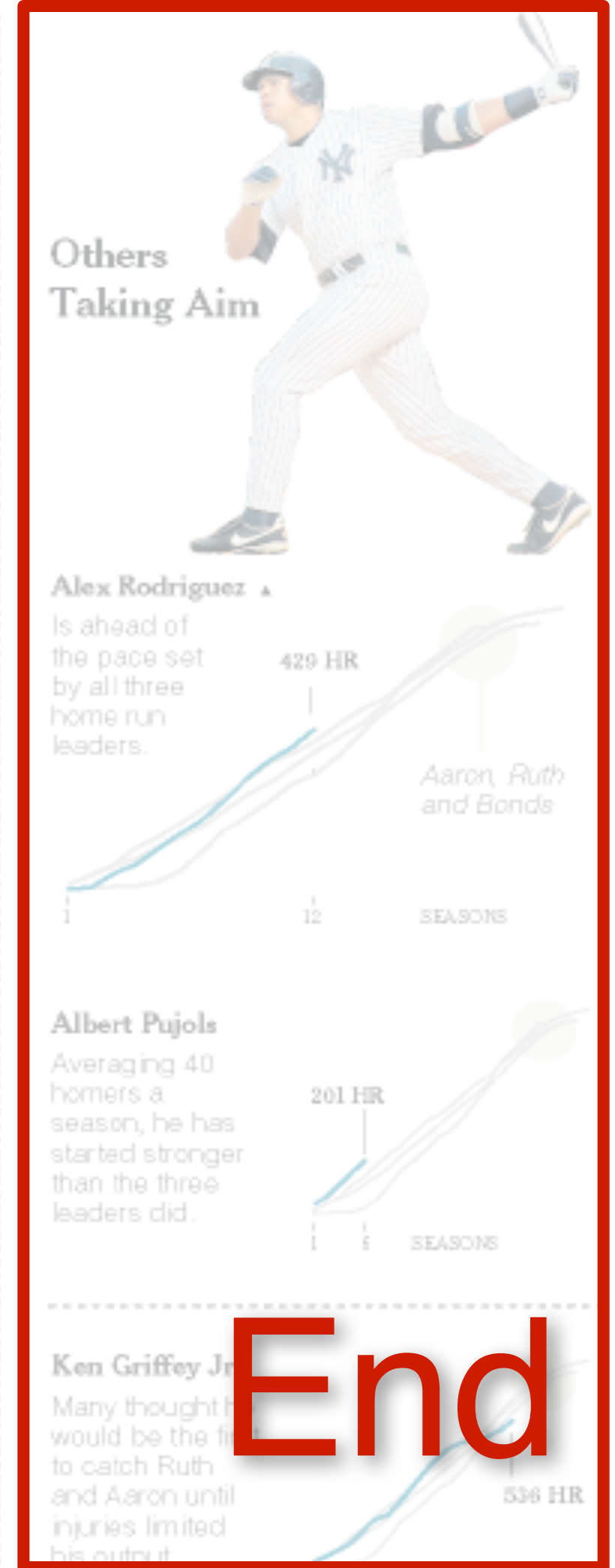
The top seven players on the career home run list, along with a look at Griffey (12th), Rodriguez (37th) and Pujols (tied 257th).





Beginning

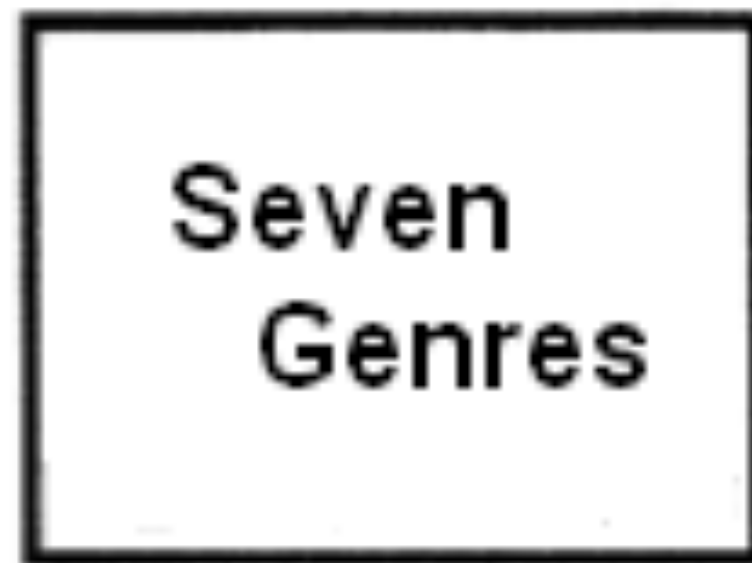
Middle



End



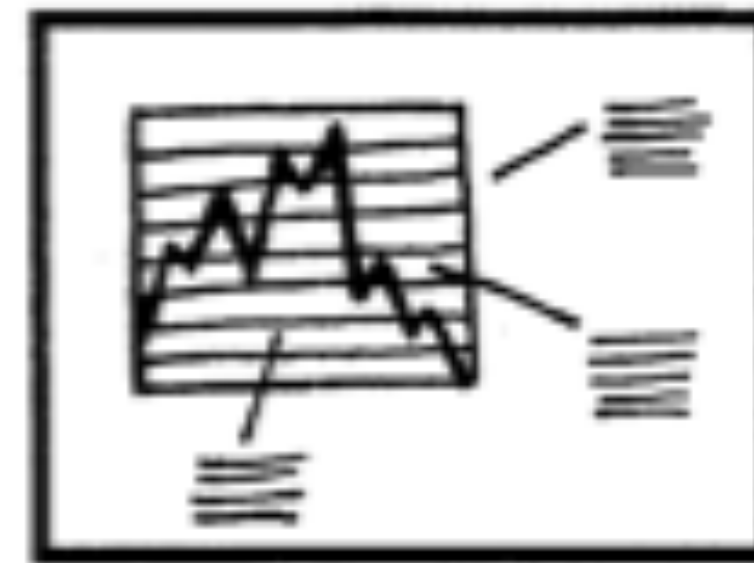
Epilogue



Seven
Genres



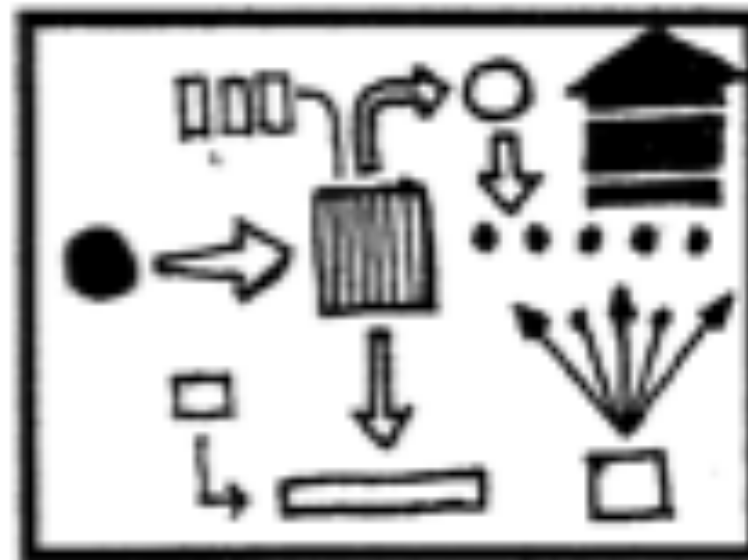
Magazine Style



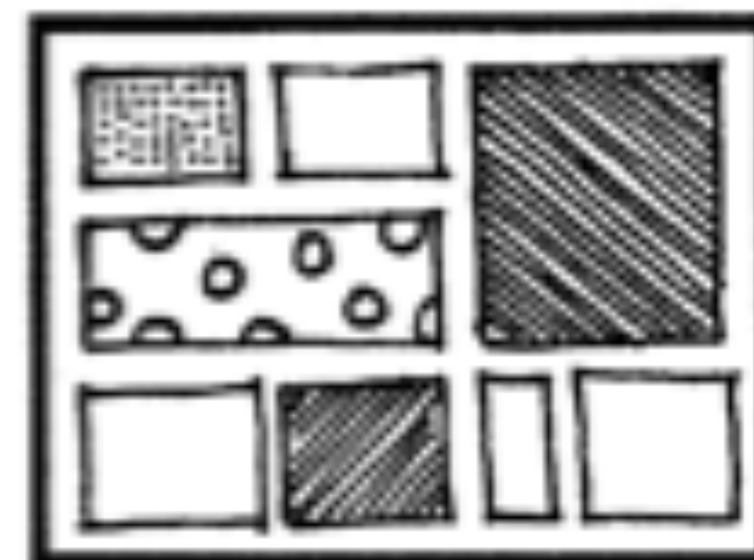
Annotated Chart



Partitioned Poster



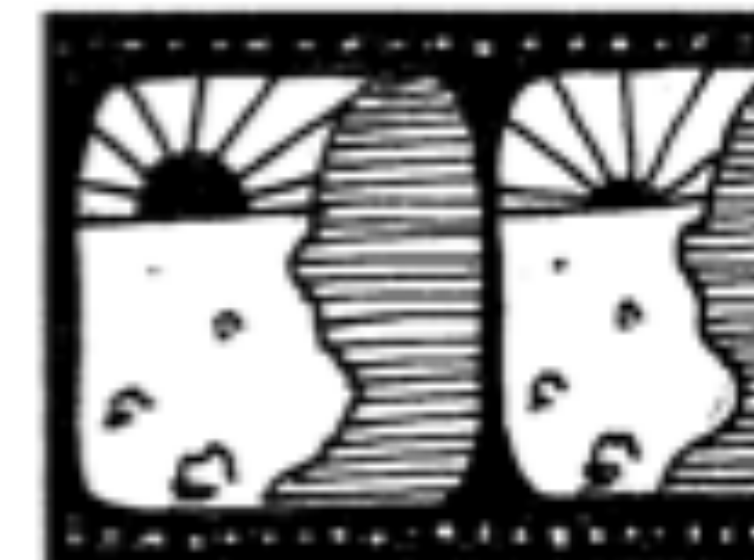
Flow Chart



Comic Strip



Slide Show



Film/Video/Animation

Genres for Narrative Visualization (2010)

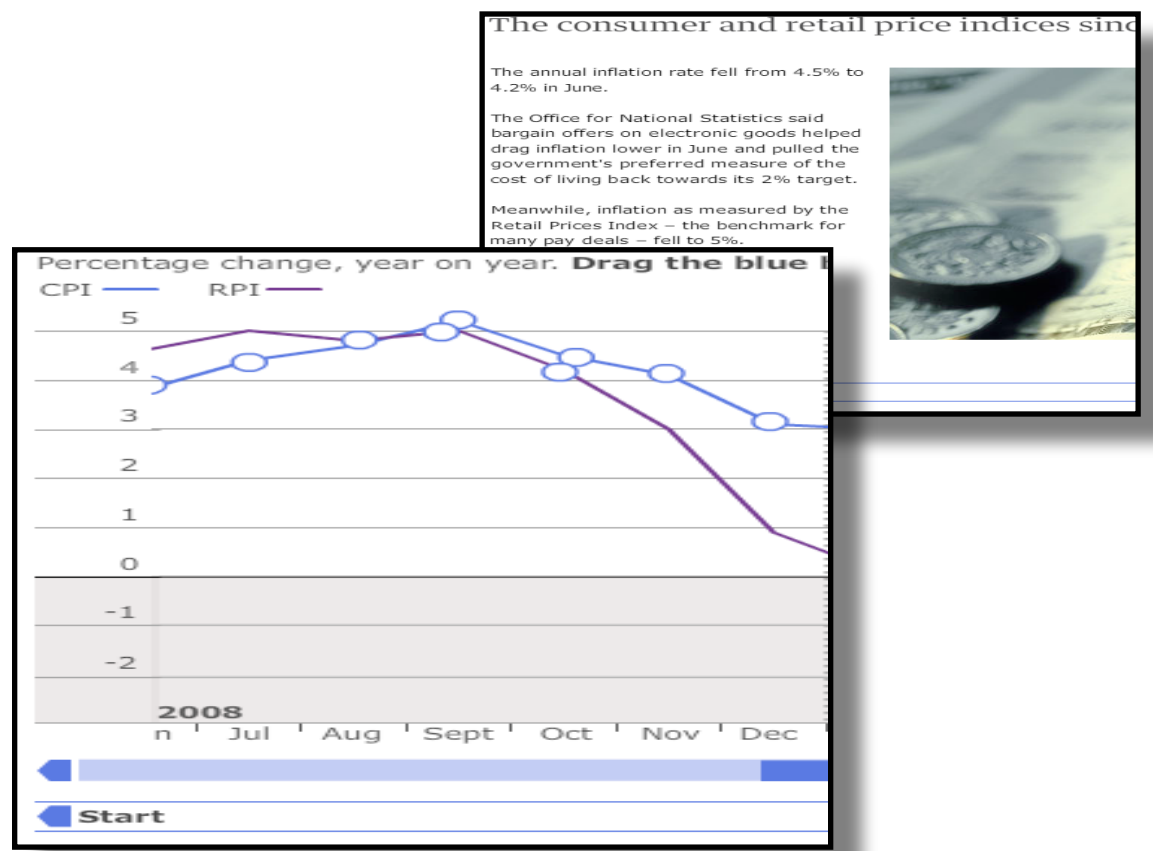
Genres + Interactivity + Messaging = DESIGN SPACE

STORYTELLING
CLARITY
SPEED

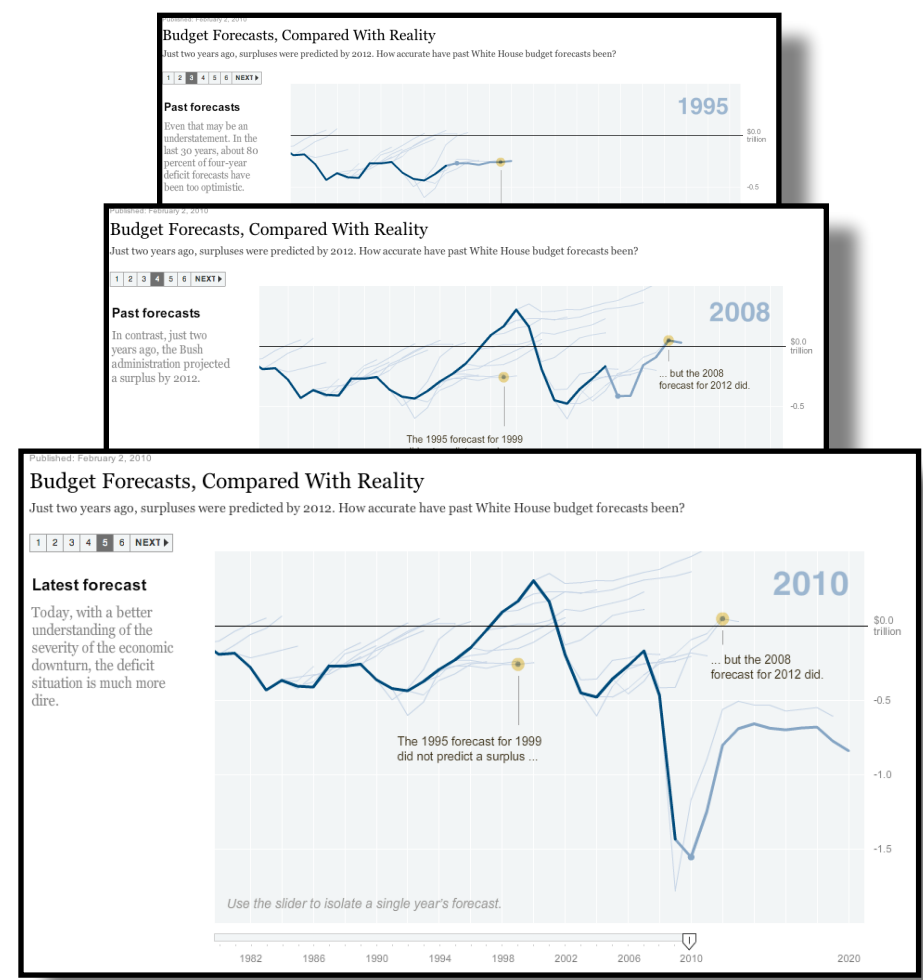
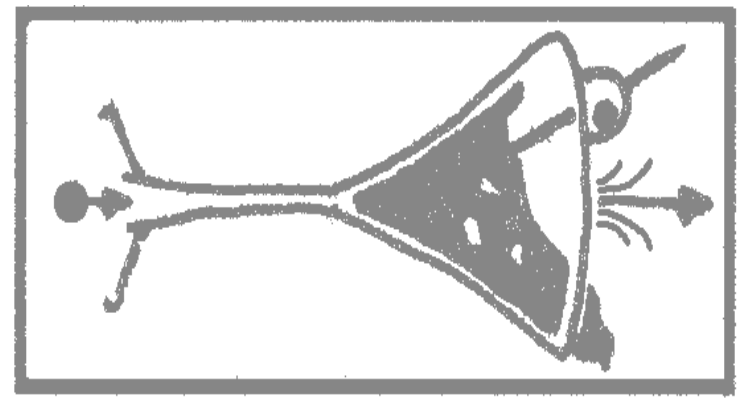
Author Driven
strong ordering
heavy messaging
limited interactivity

Reader Driven
weak ordering
light messaging
free interactivity

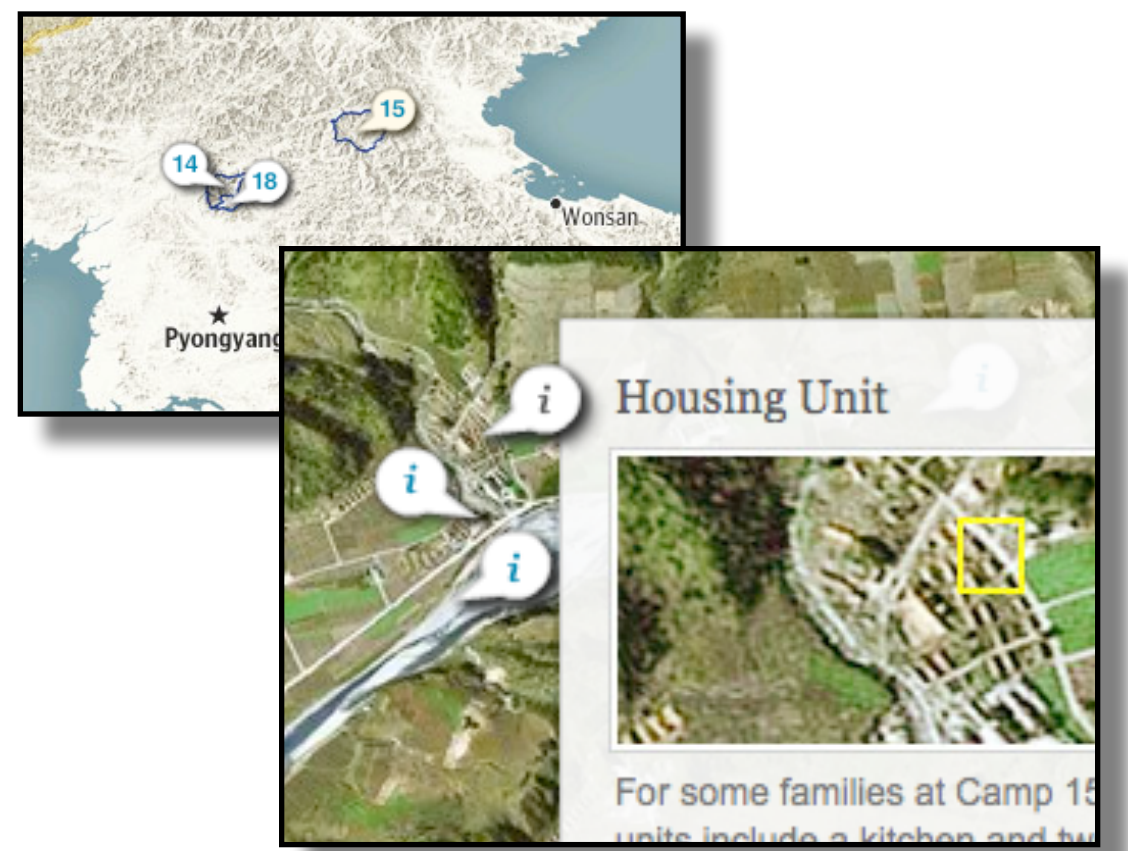
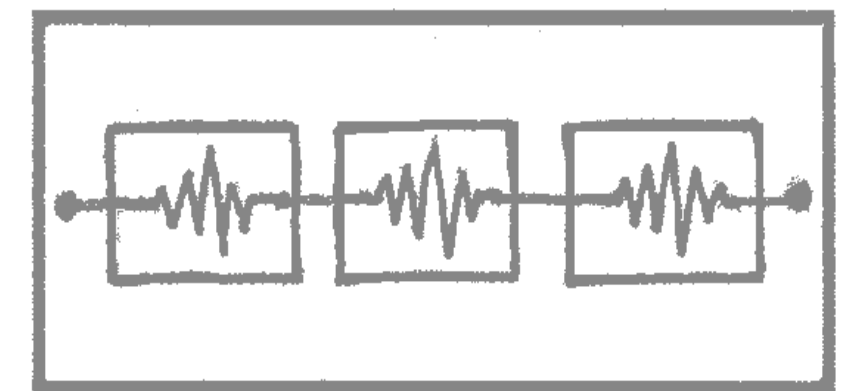
ASK QUESTIONS
EXPLORE
FIND



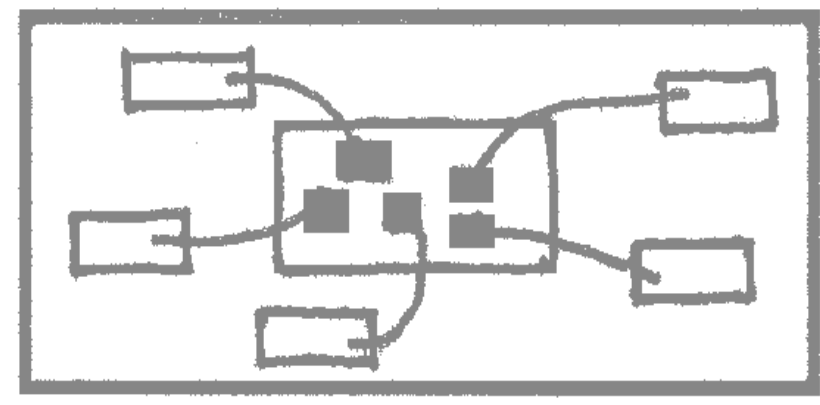
martini glass



interactive slideshow



drill-down story

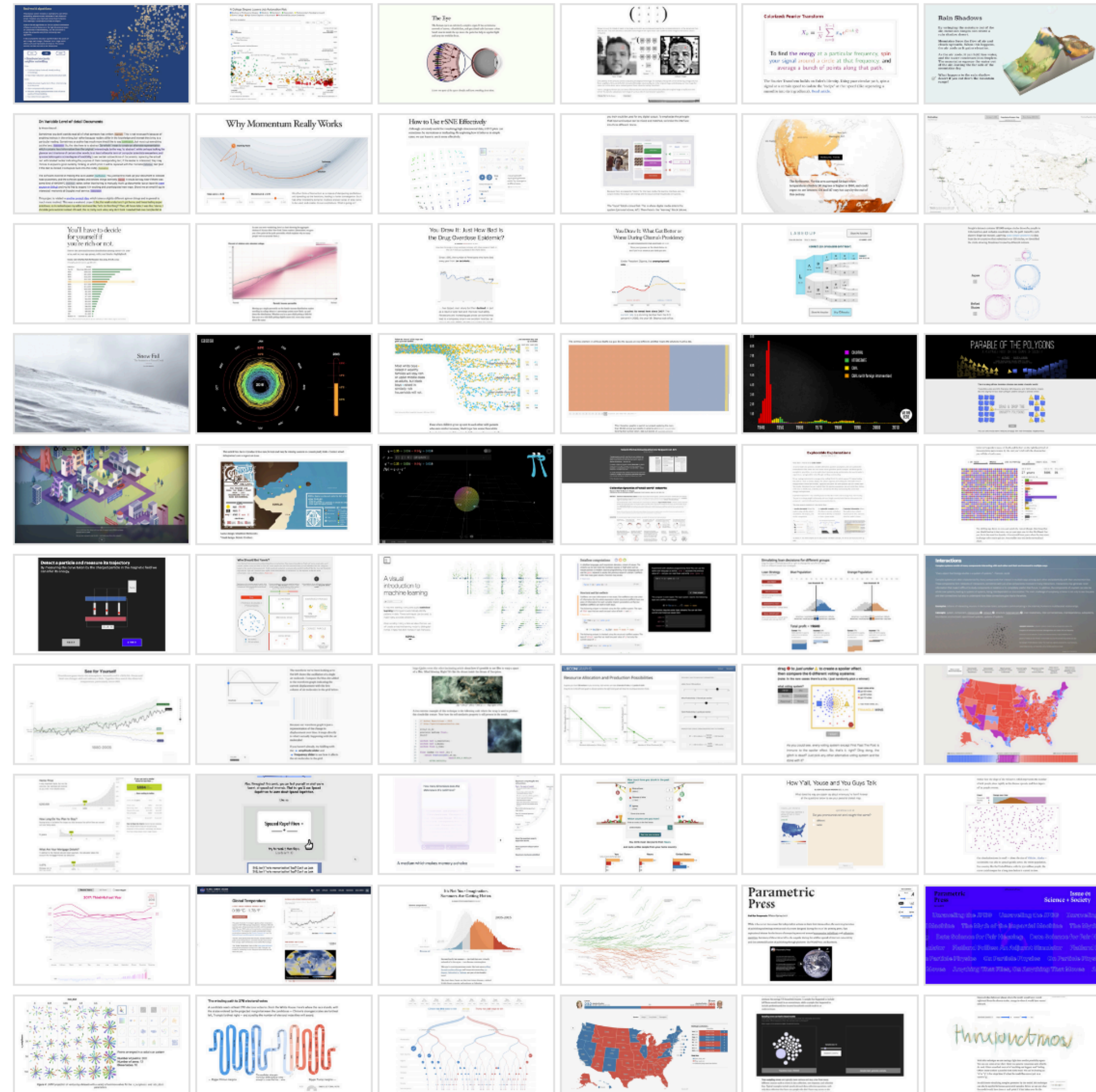


Communicating with Interactive Articles

60 Interactive Articles

NYTimes, WaPo, Distill, VisXAI, ...

Tied together research from
HCI, multimedia learning,
infovis, digital journalism



Hohman, Conlen, Heer, Chau, Distill, 2020

Interactive Articles - Design

Five affordances of the format

Connecting People and Data.

Make data pleasant to work with. Happy readers are engaged readers.

Personalizing Reading.

Let readers choose the content that is relevant to their own experience.

Making Systems Playful.

Run interactive simulations directly in the browser. No setup required.

Prompting Self-Reflection.

Help readers learn by asking them to reflect in a low pressure environment.

Reducing Cognitive Load.

Use effective representations to make complex topics more intuitive.

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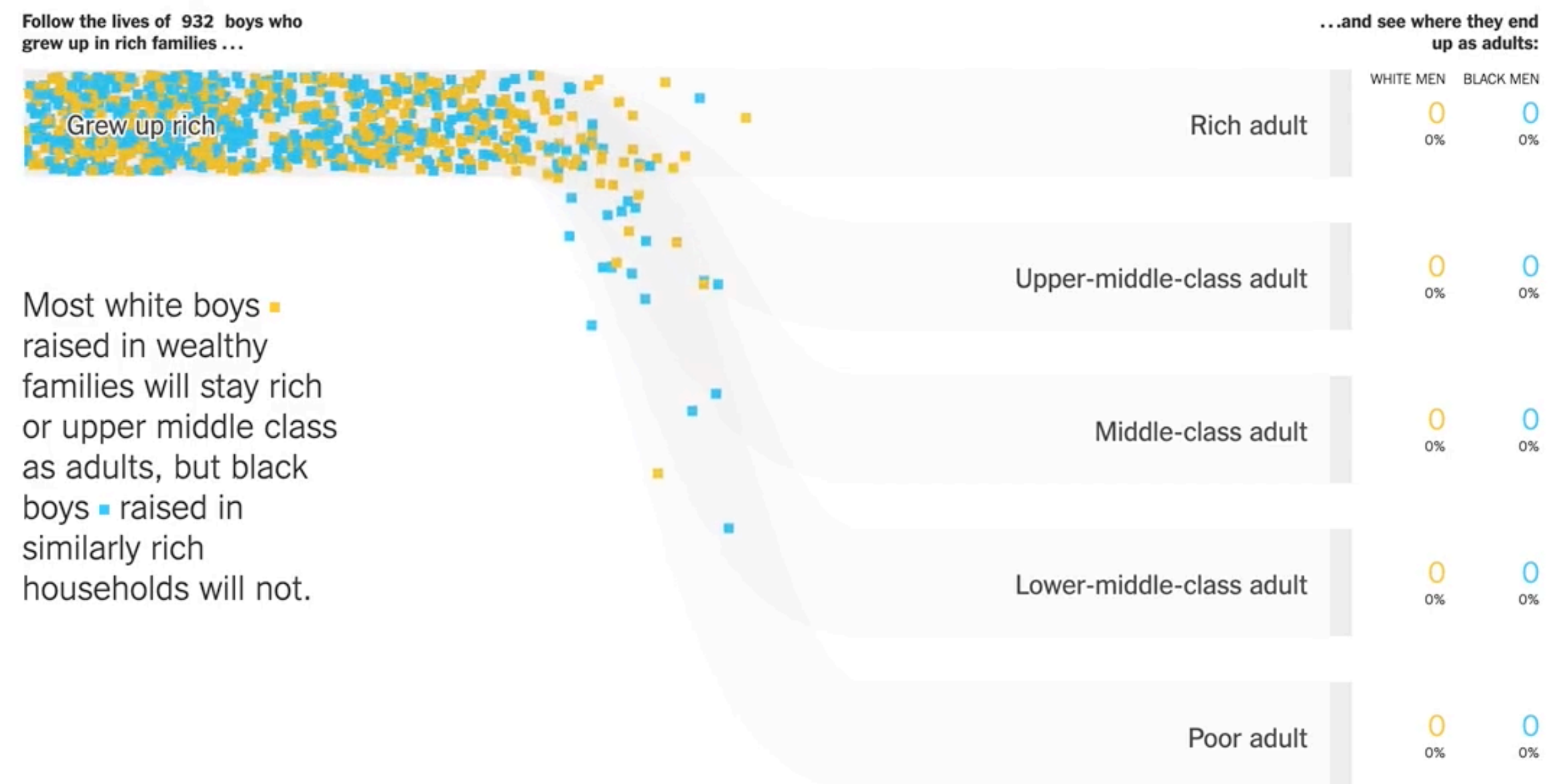
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Even when children grow up next to each other with parents who earn similar incomes, black boys fare worse than white

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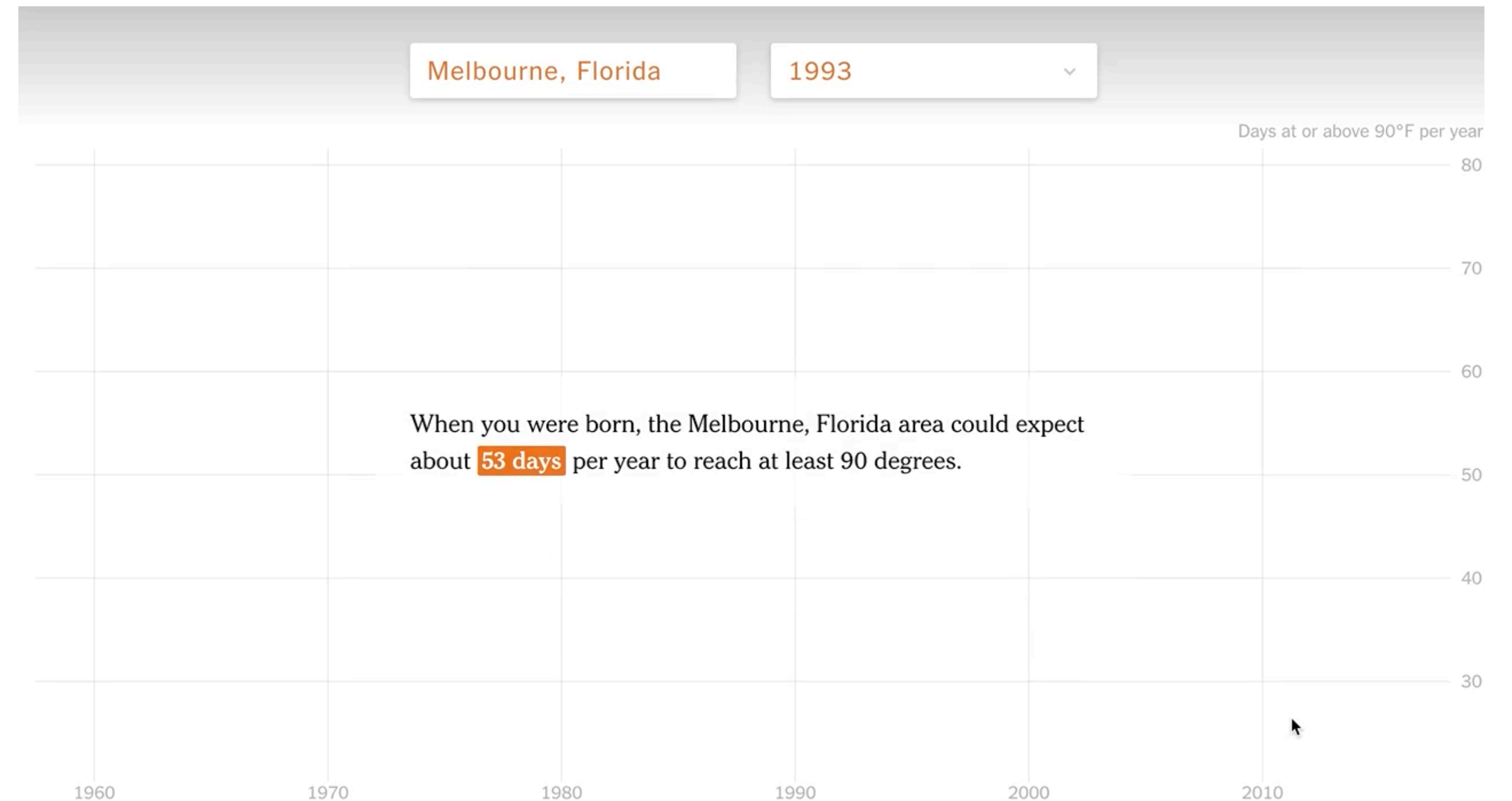
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Popovich, Migliozzi, Taylor, Williams, Watkins
NYTimes, 2018

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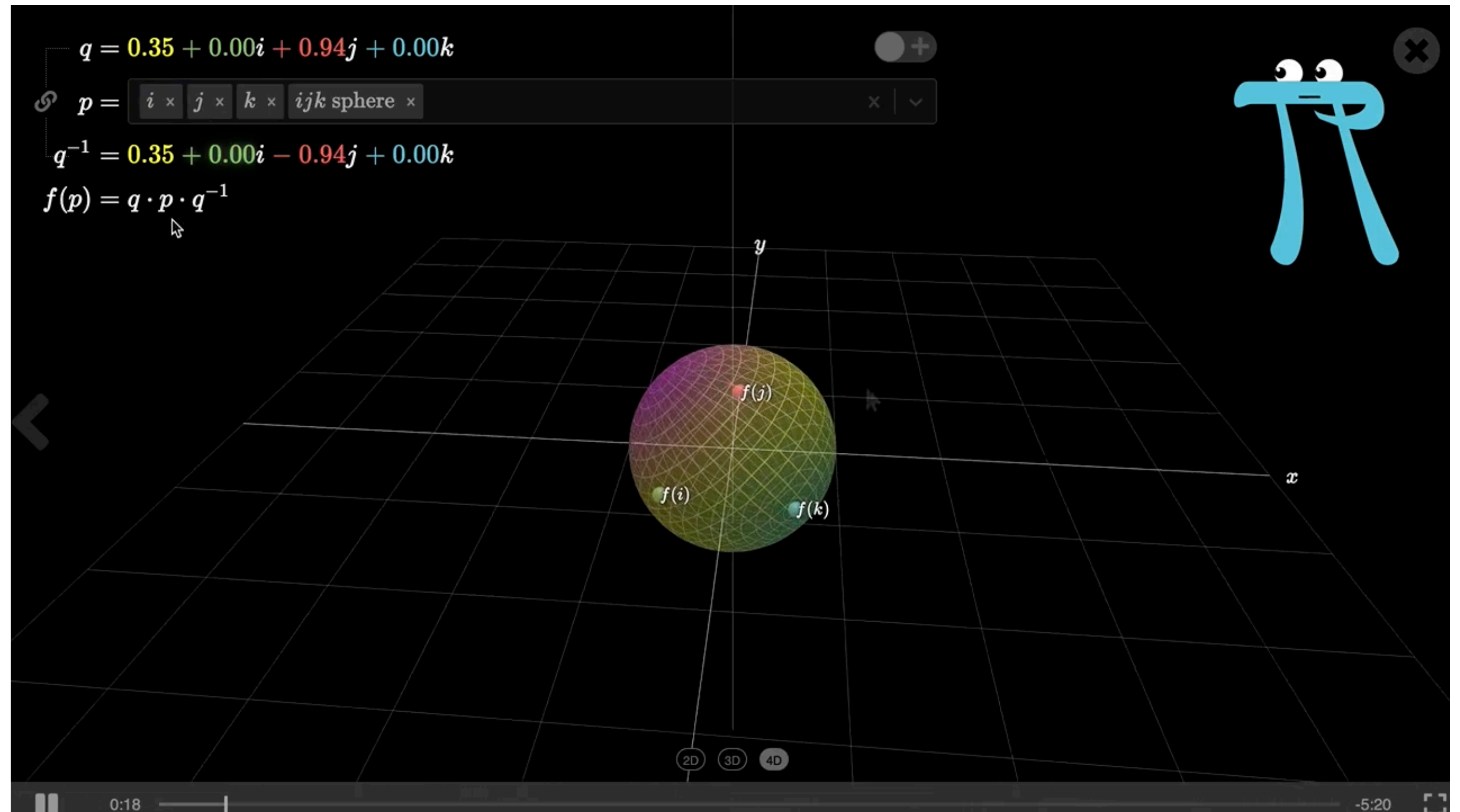
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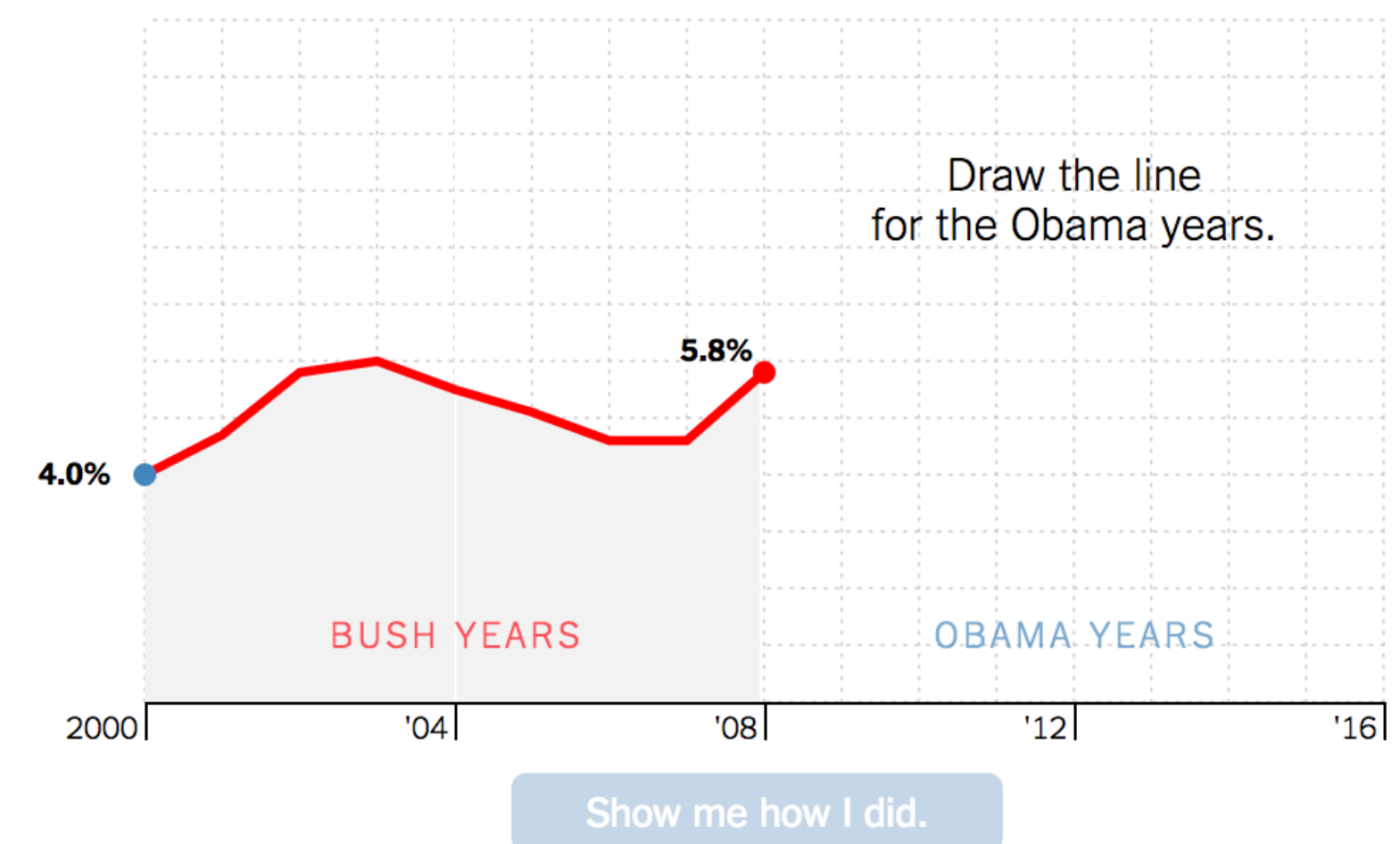
Use effective representations to make complex topics more intuitive.

You Draw It: What Got Better or Worse During Obama's Presidency

By LARRY BUCHANAN, HAEYOUN PARK and ADAM PEARCE JAN. 15, 2017

Draw your guesses on the charts below to see if you're as smart as you think you are.

Under President Obama, the **unemployment rate** ...



Buchanan, Park, Pearce, *NYTimes*, 2017

Interactive Articles - Design

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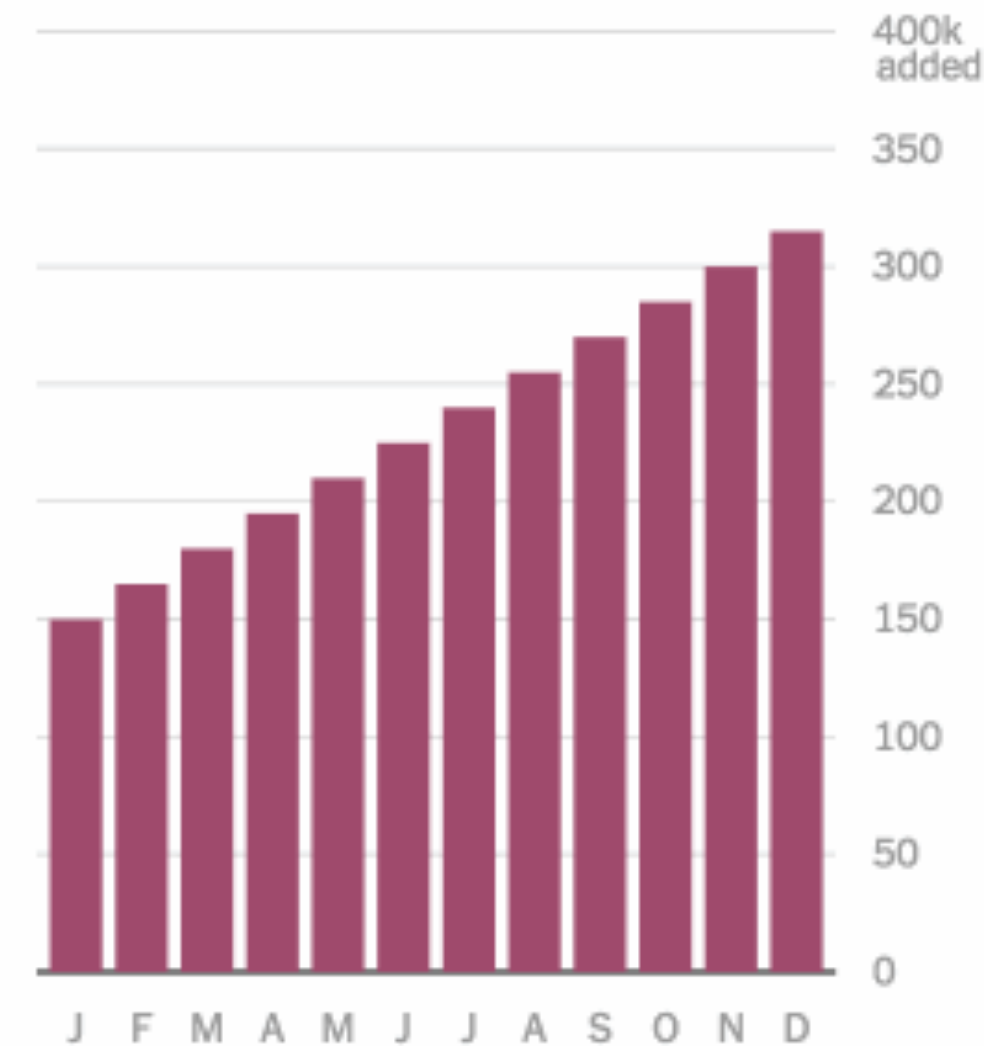
Prompting Self-Reflection.

Help readers learn by asking them to reflect in a low pressure environment.

Reducing Cognitive Load.

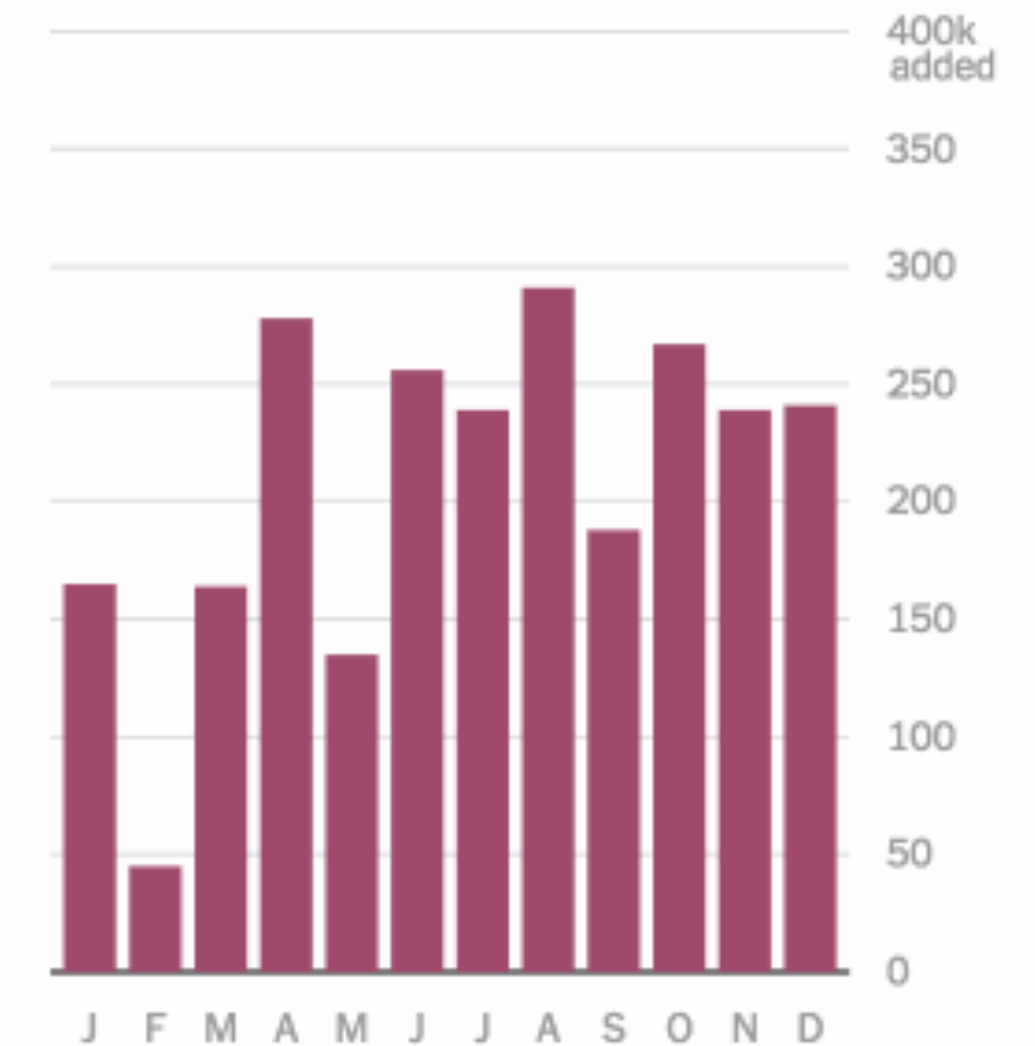
Use effective representations to make complex topics more intuitive.

If job growth **had** been accelerating...



...the jobs report could look like this:

Pause



Interactive Articles - Application

Areas of Application

Research Dissemination

Journalism

Education

Policy & Decision Making

Interactive Articles - Application

Areas of Application

Research Dissemination

Journalism

Education

Policy & Decision Making

Policy and Decision Making

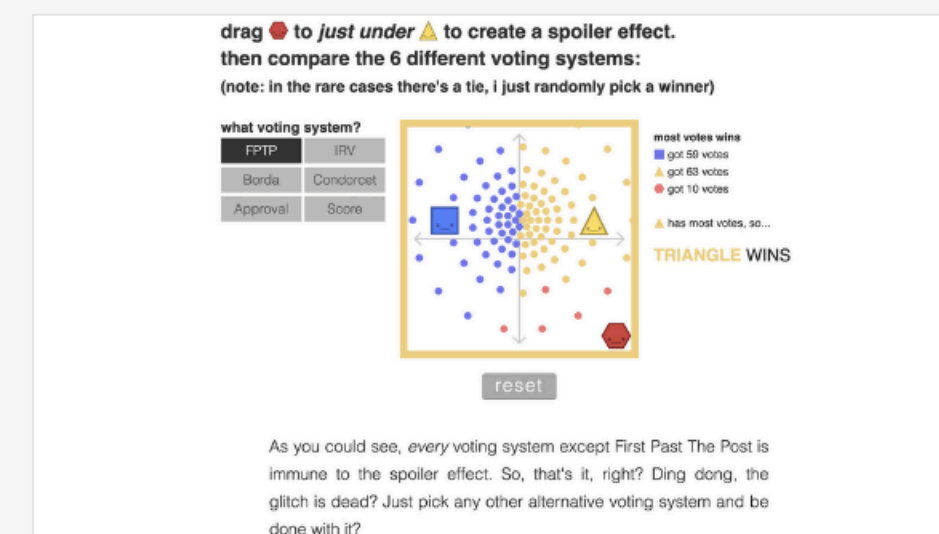
When public officials are tasked with making decisions, they are not doing it in a static, unchanging world. Politicians need to make informed decisions about complex, multifaceted problems, taking into account a variety of competing constraints, and given uncertain and changing information. So why are intelligence briefings printed on dead trees? Interactive articles offer the potential of something better, something fluid which responds to system dynamics and to changing constraints, priorities, and risk tolerance levels.

OPPORTUNITIES

- Concretize complex societal issues using experimental sandboxes
- Inform public of past, present, and future policies and their impact
- Dynamic reports that respond to changing situations and priorities

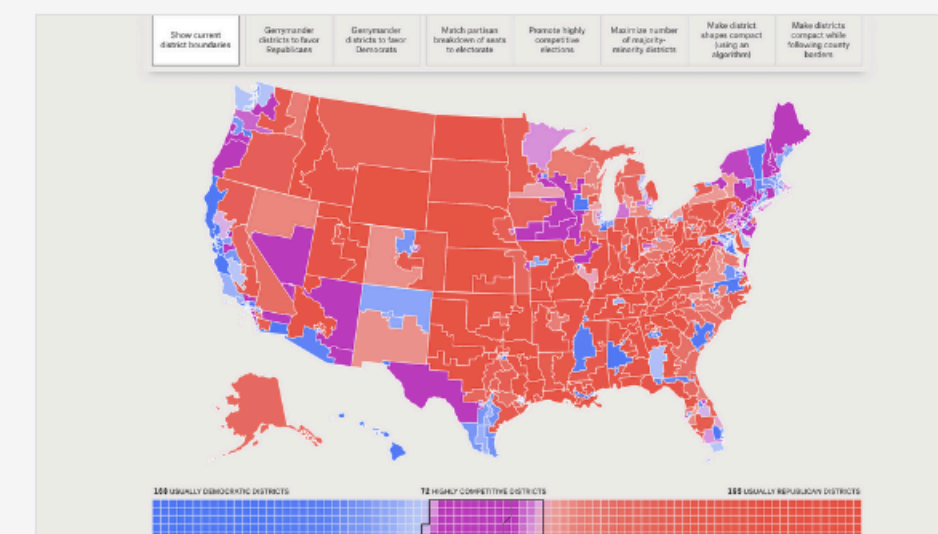
CHALLENGES

- May require greater numeracy and graphicacy in audience
- Few existing examples of effective usage by policy makers
- Danger of information overload with complex societal scenarios



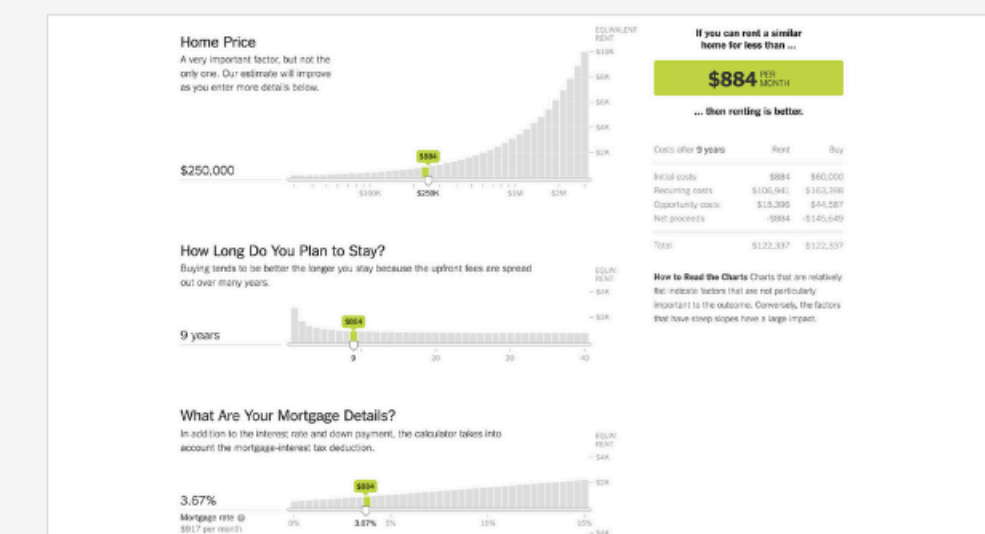
To Build a Better Ballot [22]

An explorable explanation that uses direct manipulation to show election outcomes under different voting methods to provide concrete tools for voting reform.



The Atlas Of Redistricting [23]

Visualizations of the United States and its breakdown on governmental representation and gerrymandering. Interactive toggles that redraw district boundaries compare the makeup of the US House of Representatives under different goals, both partisan and bipartisan, all without a single voter relocating.



Is It Better to Rent or Buy? [24]

Built into this article is an interactive calculator that suggests if a reader should buy or rent a property based on a collection of user-selected costs.

Challenges

Few authoring tools available

Those that do exist are too low level or lack expressivity
Not suitable for production usage

Requires general purpose programming

In practice need to be a web developer

Difficult to evaluate

Limited empirical evidence; hard to analyze usage data; lack of metrics

Lack of design guidance

Integration between text and media
Multiple output targets
How to make content accessible?

Breadth of skills required (design, programming, narrative)

Narrative Implementation

Do-It-Yourself

Monitor scroll position & element positions

Guidance: M. Bostock, J. Vallandingham

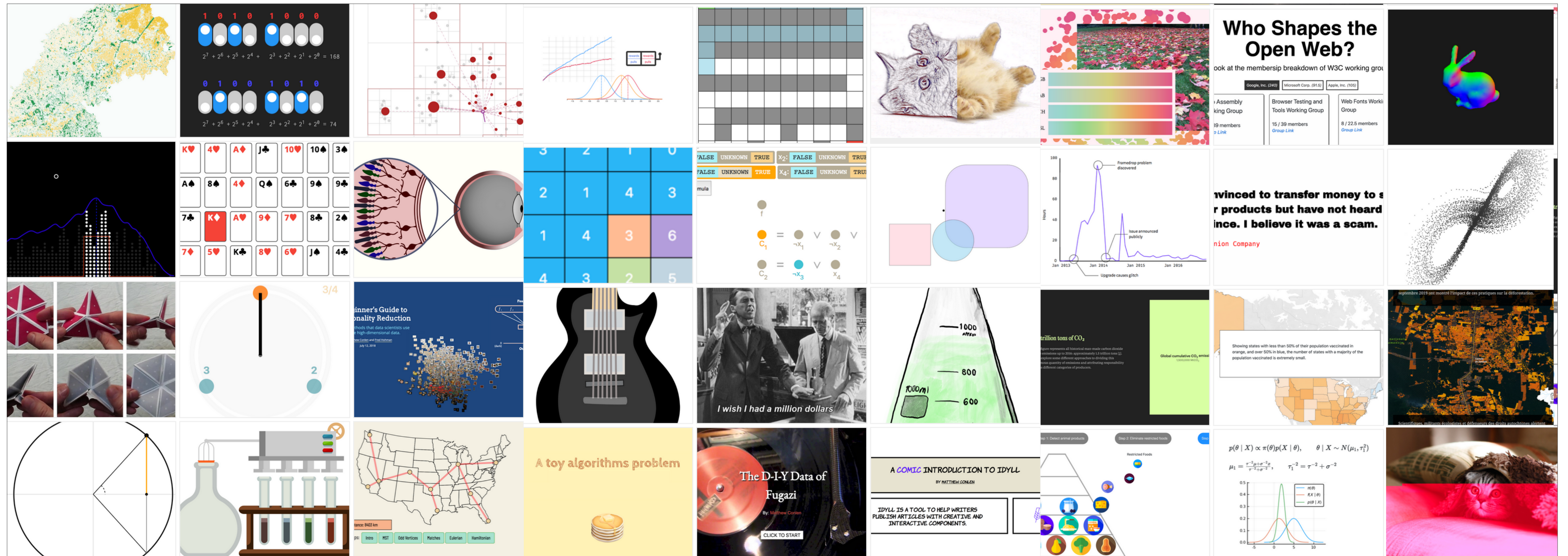
Third-Party Support

Helper Libraries

Interactive Document Formats: Idyll

Idyll

A Markup Language for Authoring and Publishing Interactive Articles on the Web



DSL for Interactive Articles

Idyll Markup

```
[Header  
title:“Hi Idyll!” /]
```

```
This is the text  
of my article.
```

```
[Graphic  
value:x /]
```

```
And that was a  
custom graphic.
```

Input:

extended markdown

domain-specific graphics

DSL for Interactive Articles

Idyll Markup

```
[Header  
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Input:

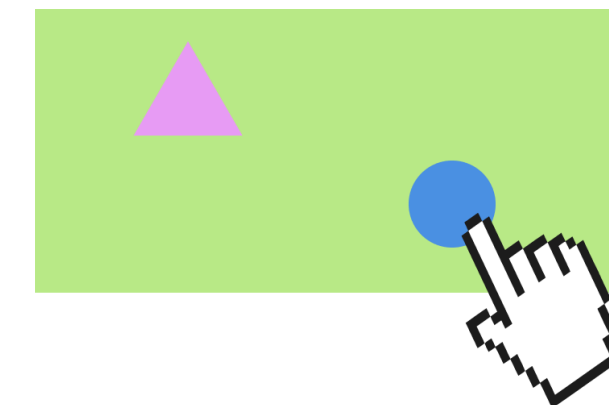
extended markdown
domain-specific graphics

Live Web Page

Hello Idyll

April 22, 2021

This is the text of
my article

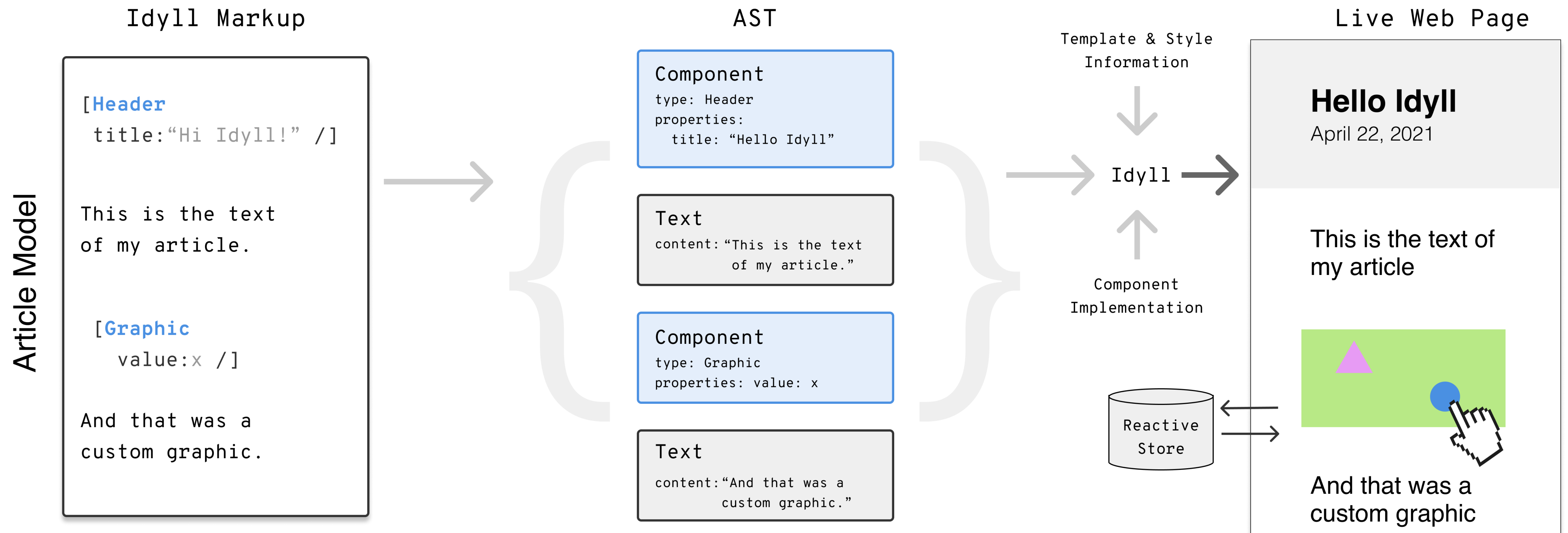


And that was a
custom graphic

Output:

javascript,html,css

DSL for Interactive Articles



interactive document schema

(Interactions, linked text+graphics, events)

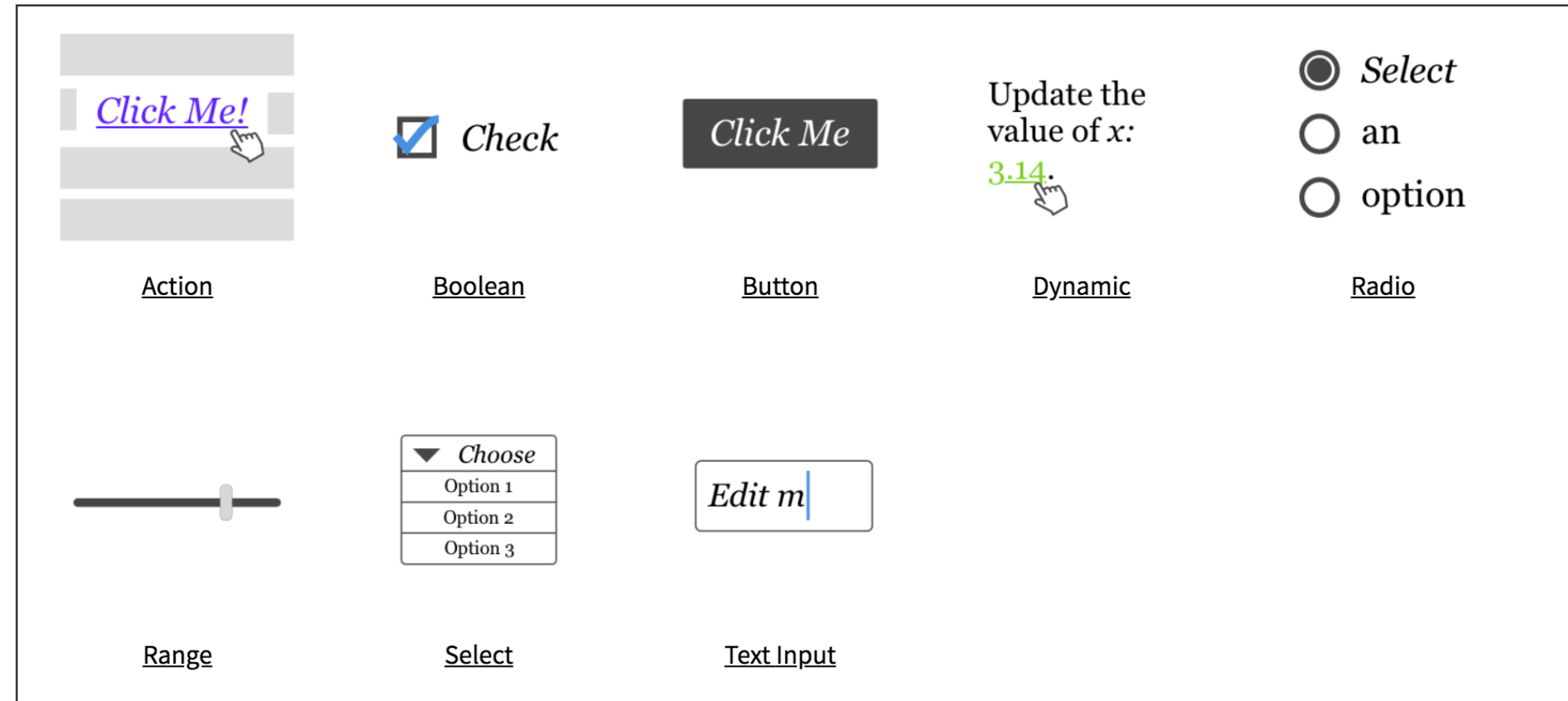
Input:

extended markdown
domain-specific graphics

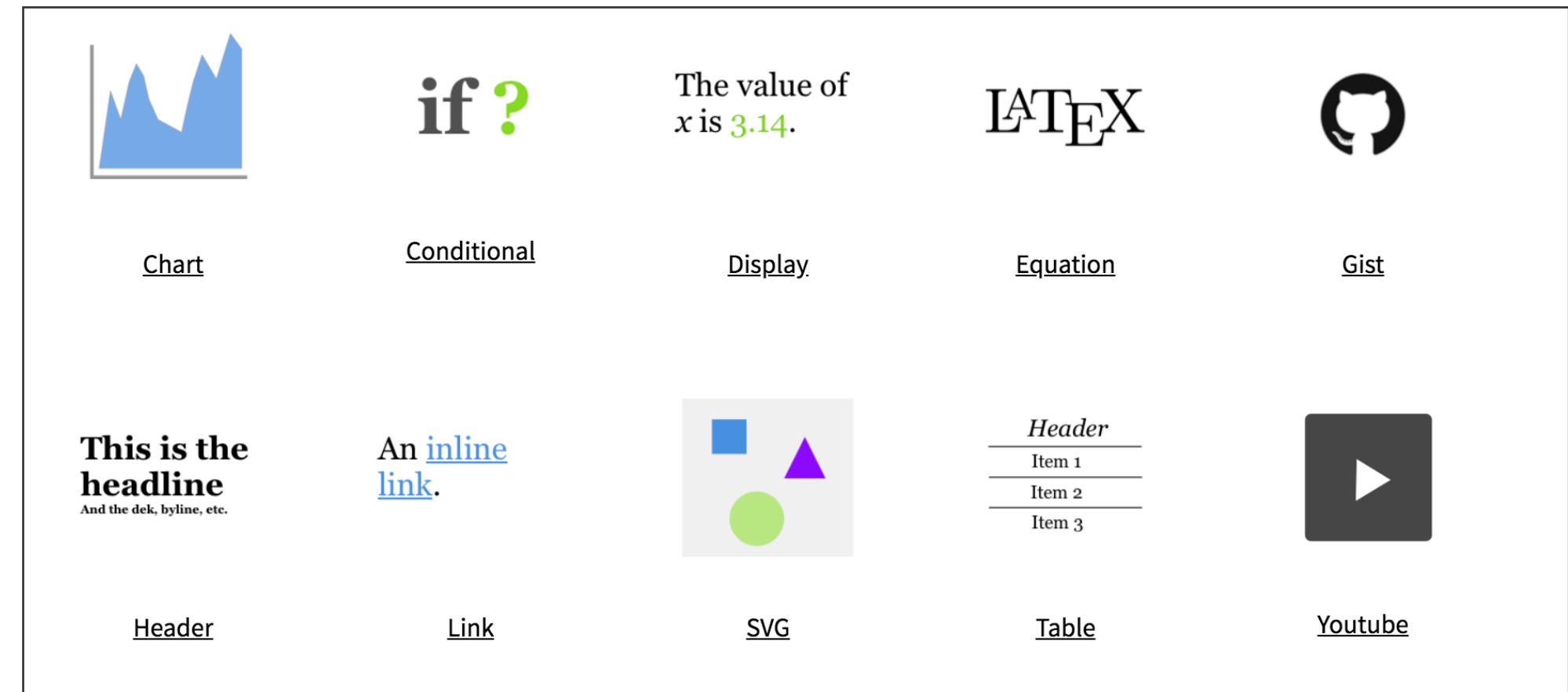
Output:

javascript,html,css

Component Library



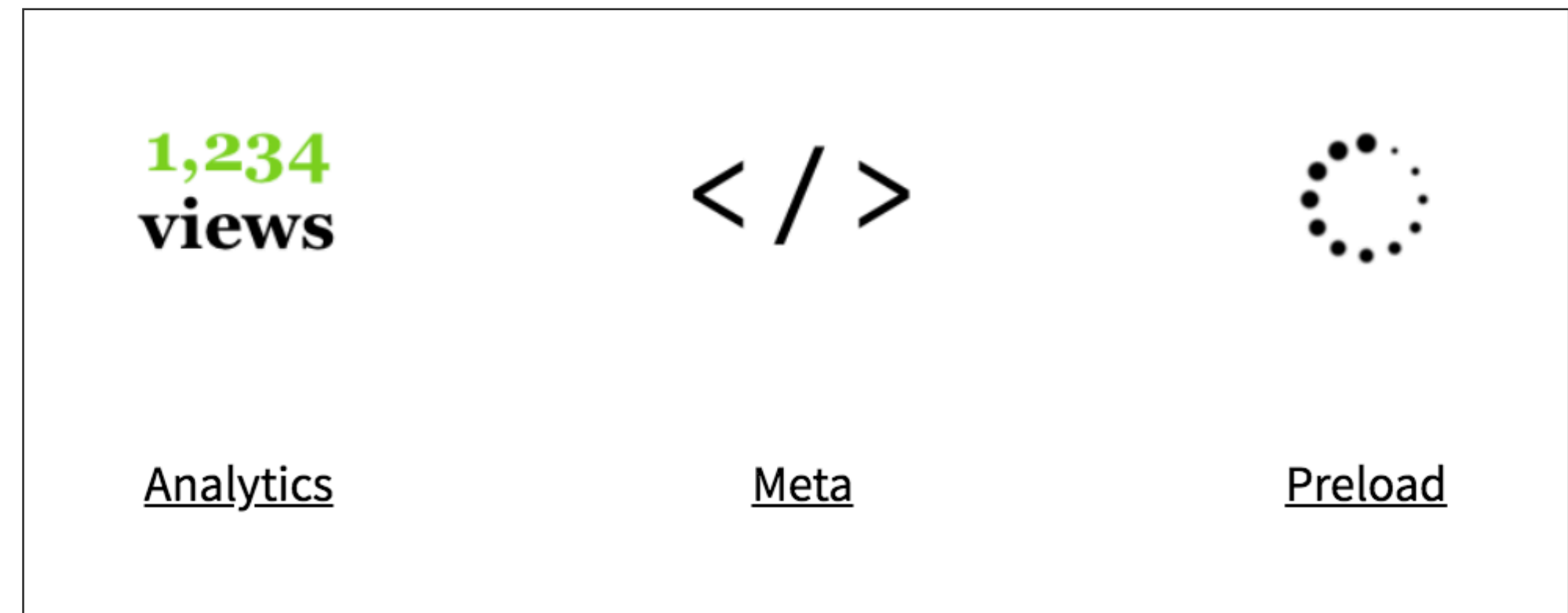
Input



Presentation



Layout



Helpers

Text + Parameterized Graphics

Write articles in
markdown.

Embed
*parameterized
graphics*.

Connect *reactive
variables* to user
input widgets to
add interactivity.

Text + Parameterized Graphics

Write articles in *markdown*.

Embed *parameterized graphics*.

Connect *reactive variables* to user input widgets to add interactivity.

INPUT (EDITABLE)

```
# Hello World
```

```
[var name:"x" value:5 /]
```

```
The value of x is [Display value:x format:"d" /].
```

```
[Range value:x min:0 max:10 /]
```

Text + Parameterized Graphics

Write articles in *markdown*.

Embed *parameterized graphics*.

Connect *reactive variables* to user input widgets to add interactivity.

INPUT (EDITABLE)

```
# Hello World

[var name:"x" value:5 /]

The value of x is [Display value:x format:"d" /].

[Range value:x min:0 max:10 /]
```

Hello World

The value of x is 5.



Bring your own graphics

A JavaScript component API is exposed to end users.

Use with libraries like D3, Vega-Lite, Mapbox, Processing (P5), React, ...

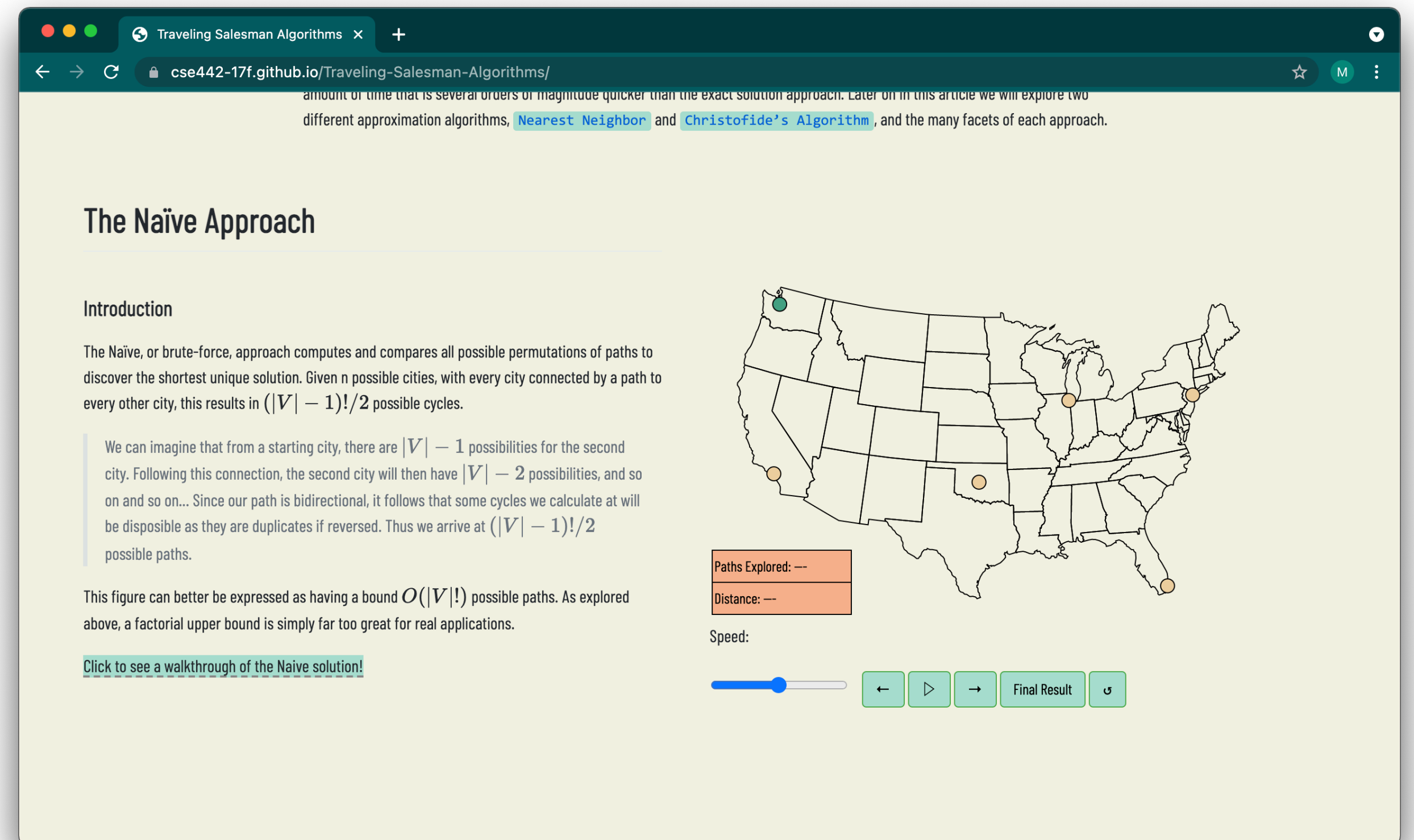


Usage

Refined design through expert interviews.

Deployed with undergrad CS students at UW.

Students successfully in creating highly customized explorable explanations of algorithms.



The screenshot shows a web browser window with the URL `cse442-17f.github.io/Traveling-Salesman-Algorithms/`. The page content includes a section titled "The Naive Approach" with an "Introduction" sub-section. The text explains that the naive approach computes all possible permutations of paths to find the shortest unique solution. It states that for n cities, there are $(|V| - 1)!/2$ possible cycles. A callout box provides a more detailed explanation: "We can imagine that from a starting city, there are $|V| - 1$ possibilities for the second city. Following this connection, the second city will then have $|V| - 2$ possibilities, and so on and so on... Since our path is bidirectional, it follows that some cycles we calculate at will be disposable as they are duplicates if reversed. Thus we arrive at $(|V| - 1)!/2$ possible paths." Below this, it notes that the number of possible paths is bounded by $O(|V|!)$ and that a factorial upper bound is too large for real applications. A link "Click to see a walkthrough of the Naive solution!" is provided. To the right of the text is an interactive map of the United States with several orange dots representing cities. Below the map are controls for "Paths Explored: --", "Distance: --", "Speed:" (with a slider), and buttons for navigation (back, play, forward) and "Final Result" (with a refresh icon).

Mathew, Cherukupalli, Pusich, Zhao, *Traveling Salesman Algorithms, CS442 '17*

Usage

Analyzed usage of language features

The screenshot shows a web browser window with the title "Traveling Salesman Algorithms". The address bar shows the URL "cse442-17f.github.io/traveling-salesman-algorithms/". The page content includes a paragraph about the Naive Approach, an introduction section, and a map of the United States with several cities marked. Below the map are controls for "Paths Explored", "Distance", "Speed", and a "Final Result" button.

amount of time that is several orders of magnitude quicker than the exact solution approach. Later on in this article we will explore two different approximation algorithms, [Nearest Neighbor](#) and [Christofide's Algorithm](#), and the many facets of each approach.

The Naïve Approach

Introduction

The Naive, or brute-force, approach computes and compares all possible permutations of paths to discover the shortest unique solution. Given n possible cities, with every city connected by a path to every other city, this results in $(|V| - 1)!/2$ possible cycles.

We can imagine that from a starting city, there are $|V| - 1$ possibilities for the second city. Following this connection, the second city will then have $|V| - 2$ possibilities, and so on and so on... Since our path is bidirectional, it follows that some cycles we calculate at will be disposable as they are duplicates if reversed. Thus we arrive at $(|V| - 1)!/2$ possible paths.

This figure can better be expressed as having a bound $O(|V|!)$ possible paths. As explored above, a factorial upper bound is simply far too great for real applications.

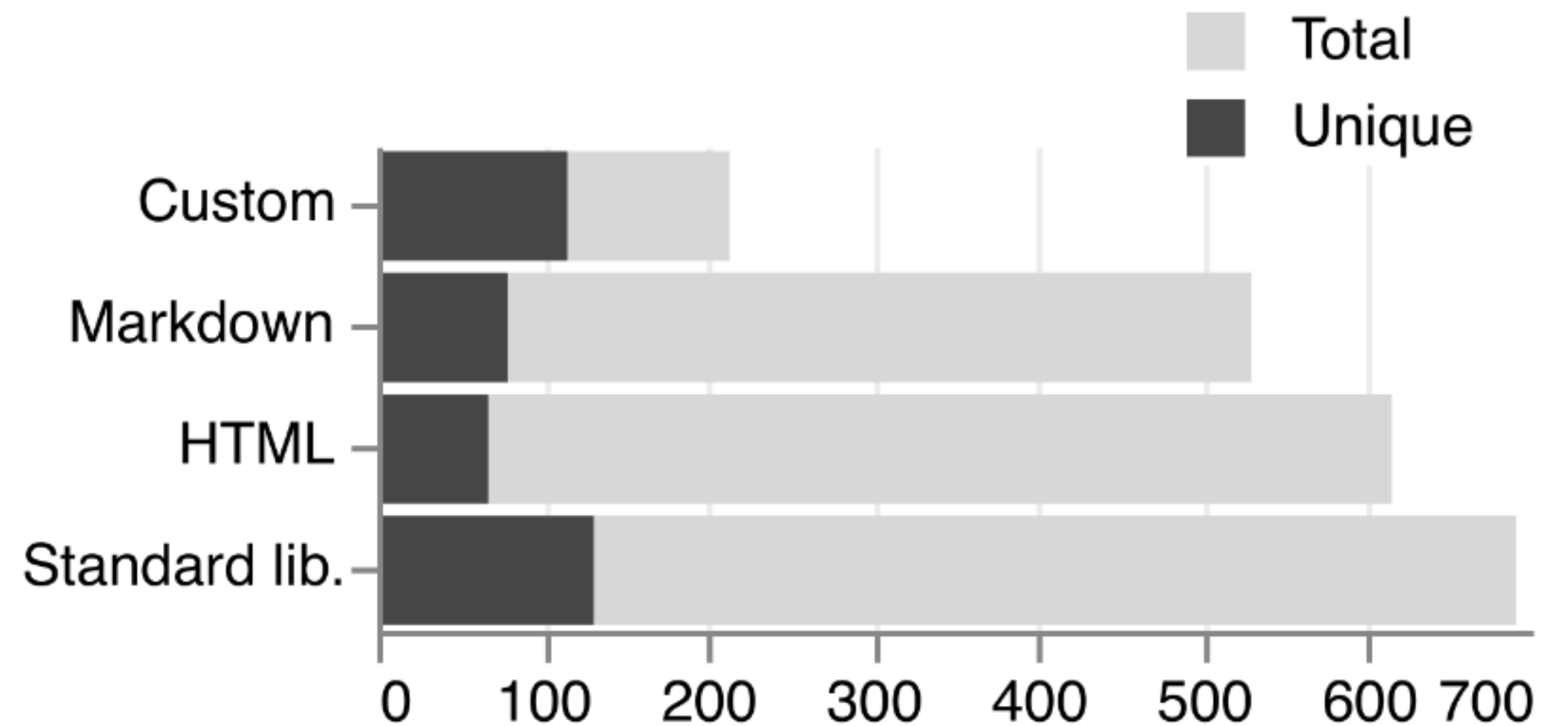
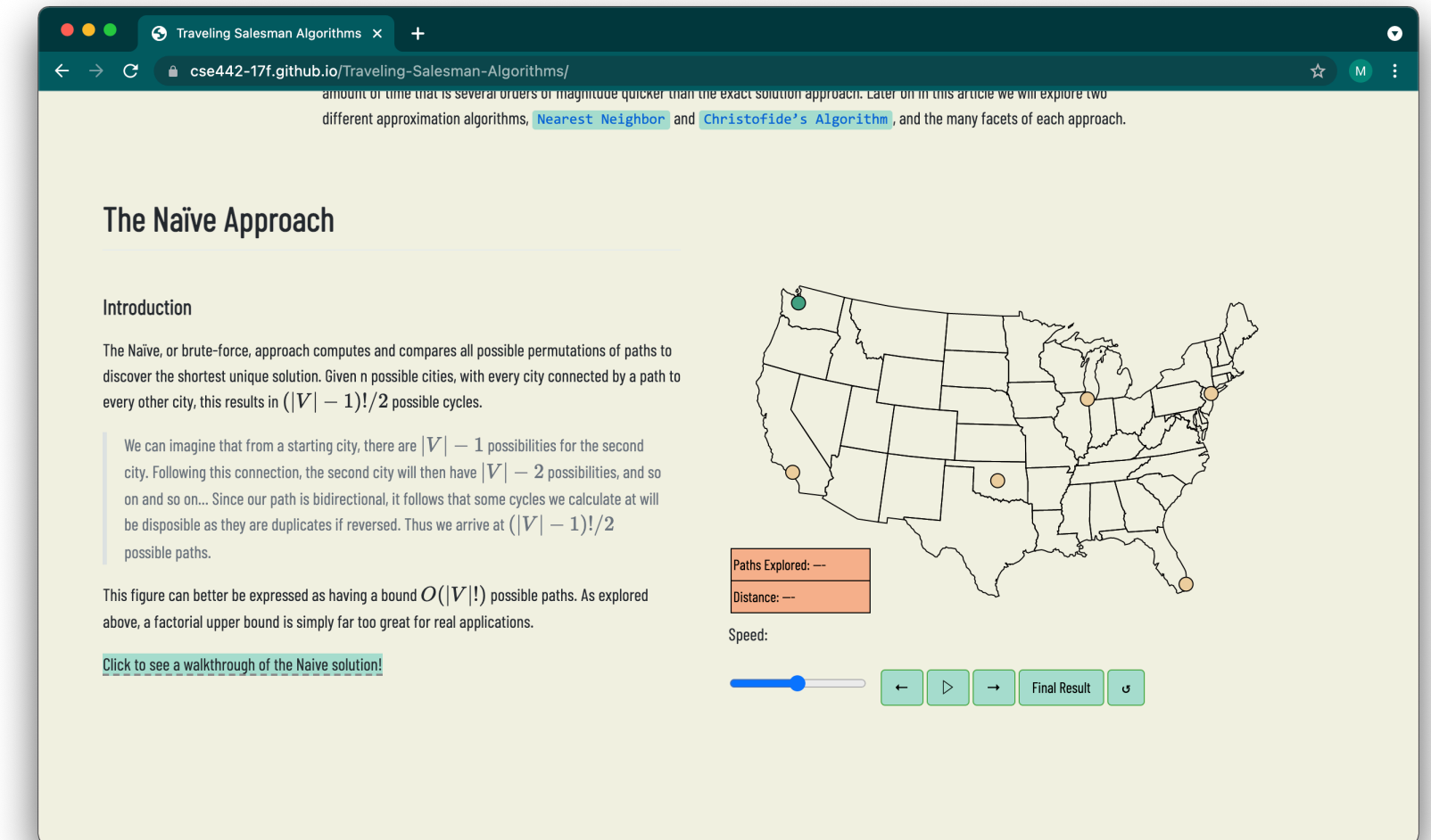
[Click to see a walkthrough of the Naive solution!](#)

Paths Explored: ---
Distance: ---
Speed: ---
Final Result

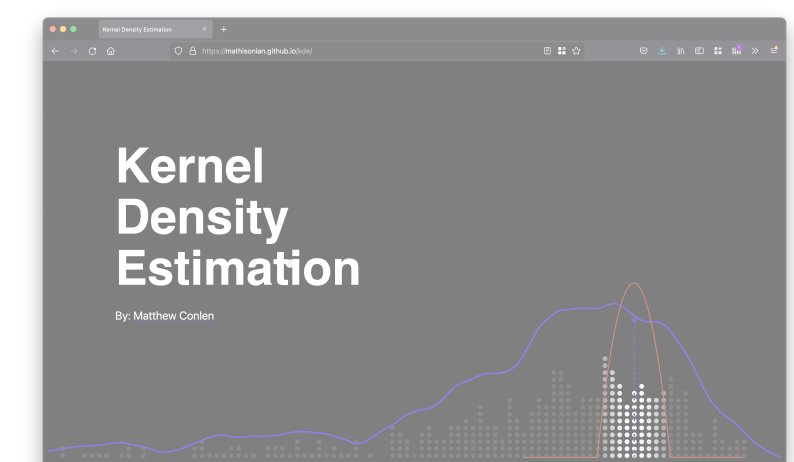
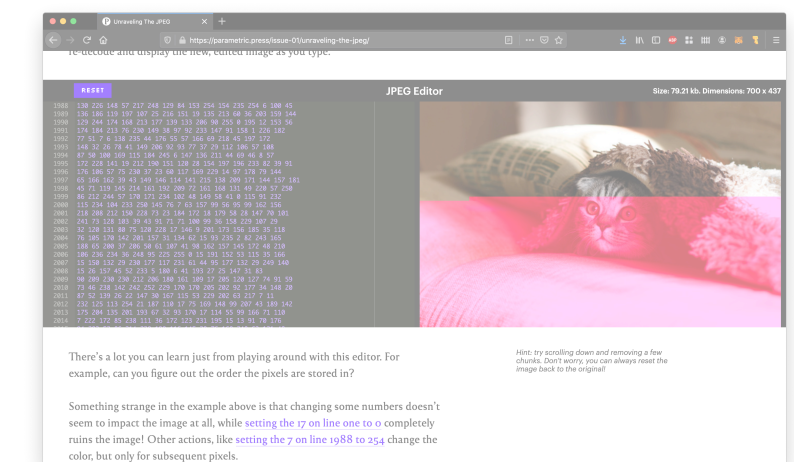
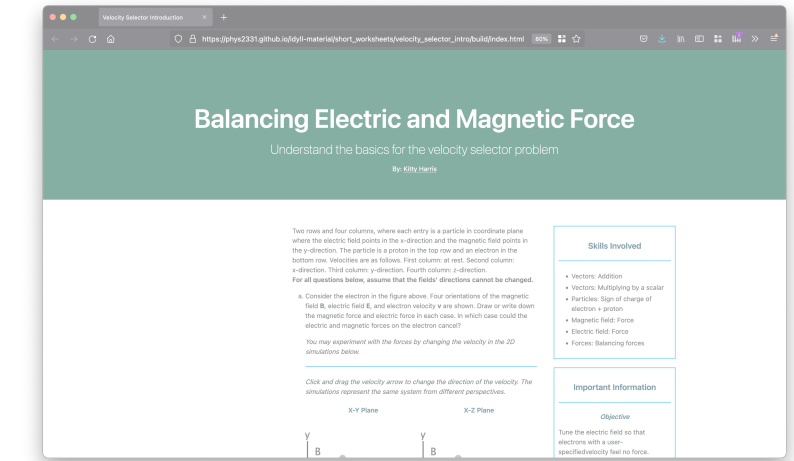
Usage

Analyzed usage of language features

Heavy use of standard components, markdown features. Still used HTML tags



Idyll in the wild



Idyll in the wild

Velocity Selector Introduction

https://phys2331.github.io/idyll-material/short_worksheets/velocity_selector_intro/build/index.html 80%

Balancing Electric and Magnetic Force

Understand the basics for the velocity selector problem

By: [Kitty Harris](#)

Two rows and four columns, where each entry is a particle in coordinate plane where the electric field points in the x-direction and the magnetic field points in the y-direction. The particle is a proton in the top row and an electron in the bottom row. Velocities are as follows. First column: at rest. Second column: x-direction. Third column: y-direction. Fourth column: z-direction. For all questions below, assume that the fields' directions cannot be changed.

a. Consider the electron in the figure above. Four orientations of the magnetic field \mathbf{B} , electric field \mathbf{E} , and electron velocity \mathbf{v} are shown. Draw or write down the magnetic force and electric force in each case. In which case could the electric and magnetic forces on the electron cancel?

You may experiment with the forces by changing the velocity in the 2D simulations below.

Click and drag the velocity arrow to change the direction of the velocity. The simulations represent the same system from different perspectives.

X-Y Plane X-Z Plane

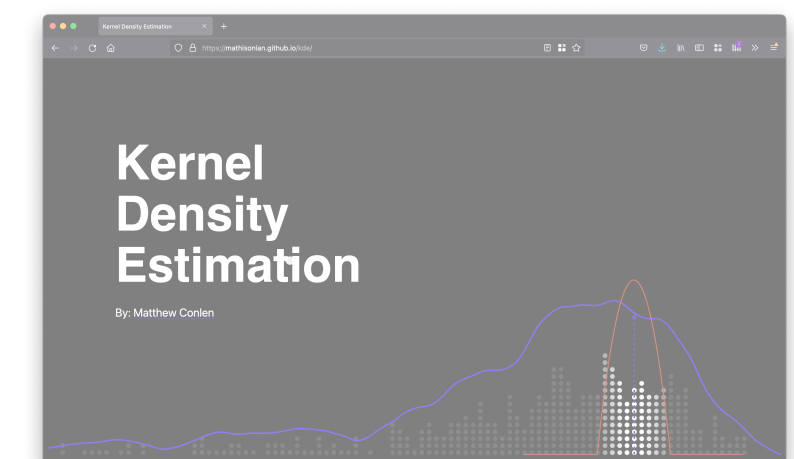
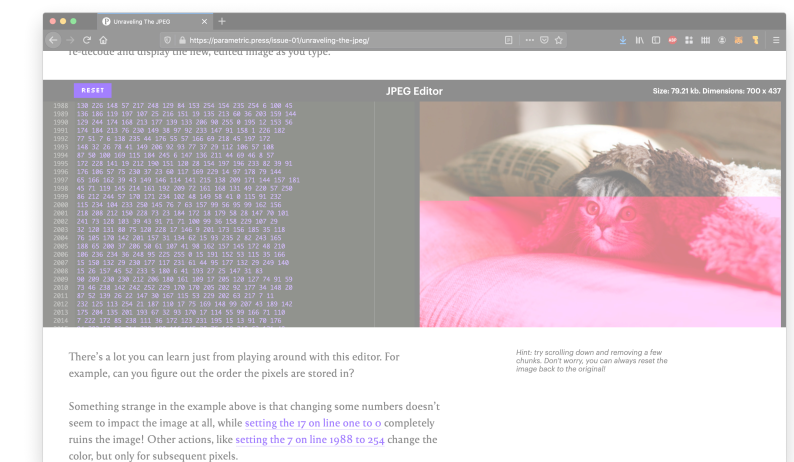
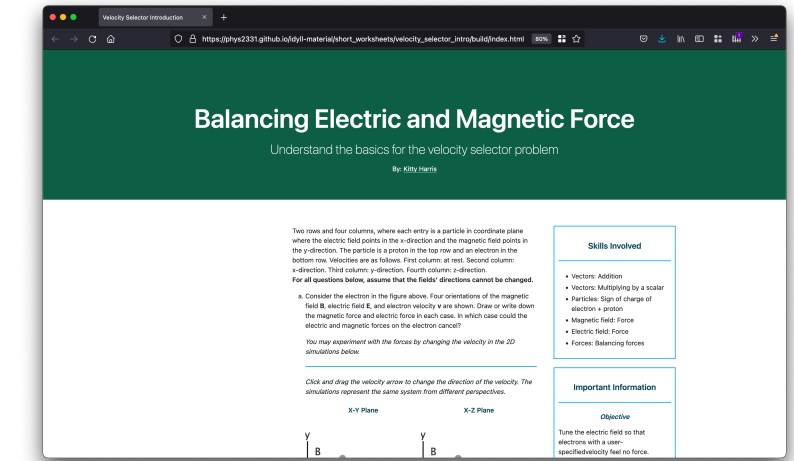
Skills Involved

- Vectors: Addition
- Vectors: Multiplying by a scalar
- Particles: Sign of charge of electron + proton
- Magnetic field: Force
- Electric field: Force
- Forces: Balancing forces

Important Information

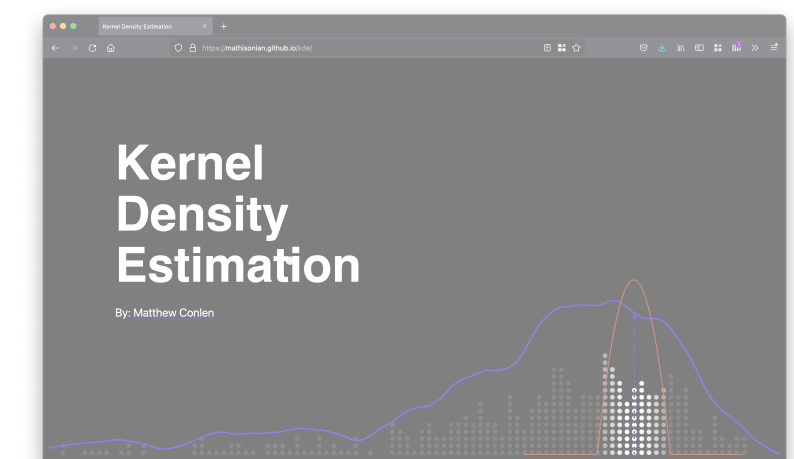
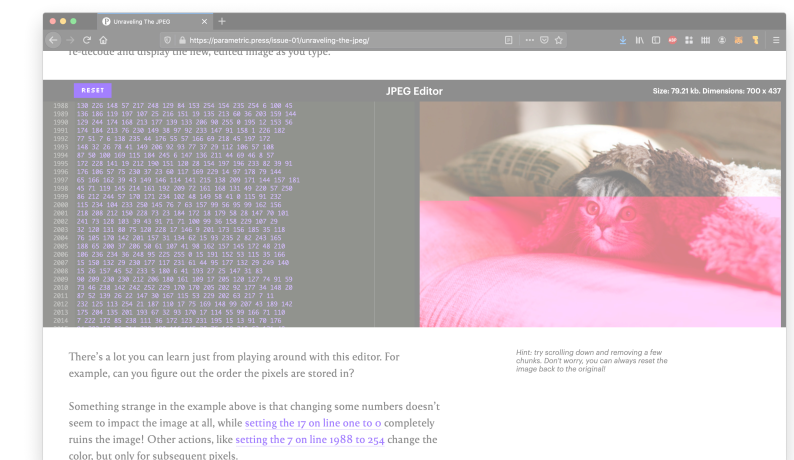
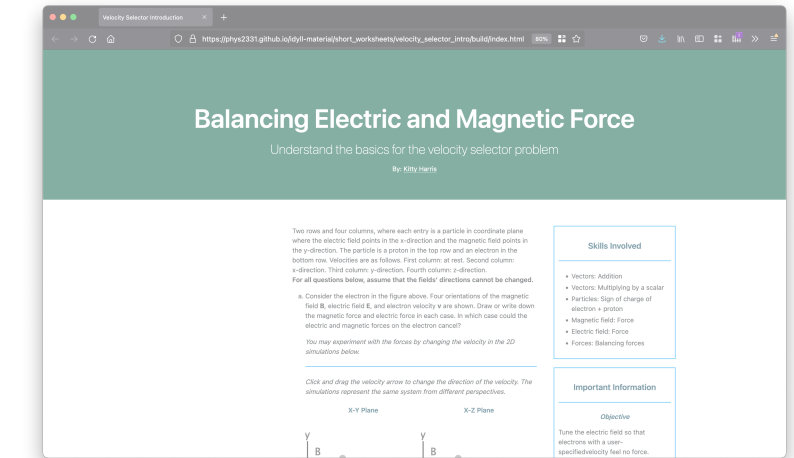
Objective

Tune the electric field so that electrons with a user-specified velocity feel no force.



UC Denver
Undergraduate physics material (interactive worksheets)

Idyll in the wild



UK Infrastructure Transitions Research Consortium
Interactive presentation of urban development models

Idyll in the wild

re-decode and display the new, edited image as you type.

RESET

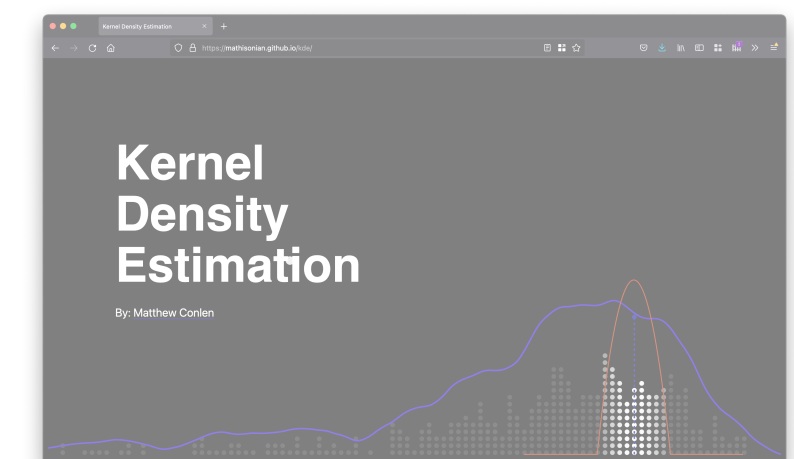
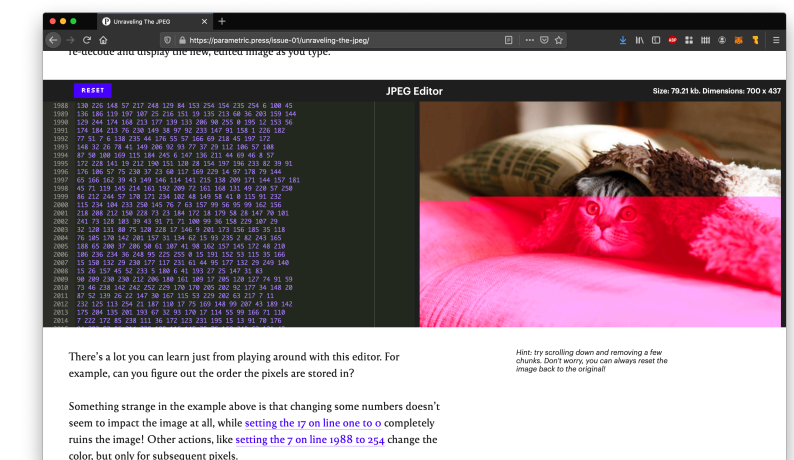
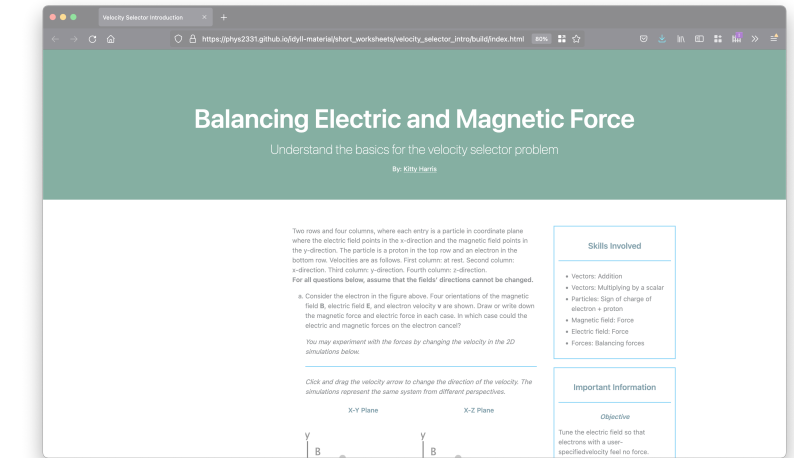
JPEG Editor Size: 79.21 kb. Dimensions: 700 x 437

```
1988 130 226 148 57 217 248 129 84 153 254 154 235 254 6 100 45
1989 136 186 119 197 107 25 216 151 19 135 213 60 36 203 159 144
1990 129 244 174 168 213 177 139 133 206 90 255 0 195 12 153 56
1991 174 184 213 76 230 149 38 97 92 233 147 91 158 1 226 182
1992 77 51 7 6 138 235 44 176 55 57 166 69 218 45 197 172
1993 148 32 26 78 41 149 206 92 93 77 37 29 112 106 57 108
1994 87 50 100 169 115 184 245 6 147 136 211 44 69 46 8 57
1995 172 228 141 19 212 190 151 120 28 154 197 196 233 82 39 91
1996 176 106 57 75 230 37 23 60 117 169 229 14 97 178 79 144
1997 65 166 162 39 43 149 146 114 141 215 138 209 171 144 157 181
1998 45 71 119 145 214 161 192 209 72 161 168 131 49 220 57 250
1999 86 212 244 57 170 171 234 102 48 149 58 41 0 115 91 232
2000 115 234 104 233 250 145 76 7 63 157 99 56 95 99 162 156
2001 218 208 212 150 228 73 23 184 172 18 179 58 28 147 70 101
2002 241 73 128 103 39 43 91 71 71 100 99 36 158 229 107 29
2003 32 120 131 80 75 120 228 17 146 9 201 173 156 185 35 118
2004 76 105 170 142 201 157 31 134 62 15 93 235 2 82 243 165
2005 188 65 200 37 206 50 61 107 41 98 162 157 145 172 48 210
2006 106 236 234 36 248 95 225 255 0 15 191 152 53 115 35 166
2007 15 150 132 29 230 177 117 231 61 44 95 177 132 29 249 140
2008 15 26 157 45 52 233 5 180 6 41 193 27 25 147 31 83
2009 90 209 230 230 212 206 180 161 109 17 205 120 127 74 91 59
2010 73 46 238 142 242 252 229 170 170 205 202 92 177 34 148 20
2011 87 52 139 26 22 147 30 167 115 53 229 202 63 217 7 11
2012 232 125 113 254 21 187 110 17 75 169 148 99 207 43 189 142
2013 175 204 135 201 193 67 32 93 170 17 114 55 99 166 71 110
2014 7 222 172 85 238 111 36 172 123 231 195 15 13 91 70 176
```

There's a lot you can learn just from playing around with this editor. For example, can you figure out the order the pixels are stored in?

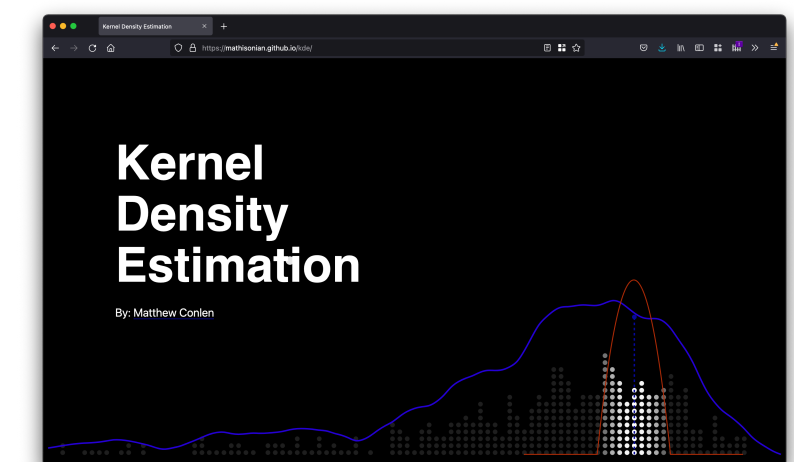
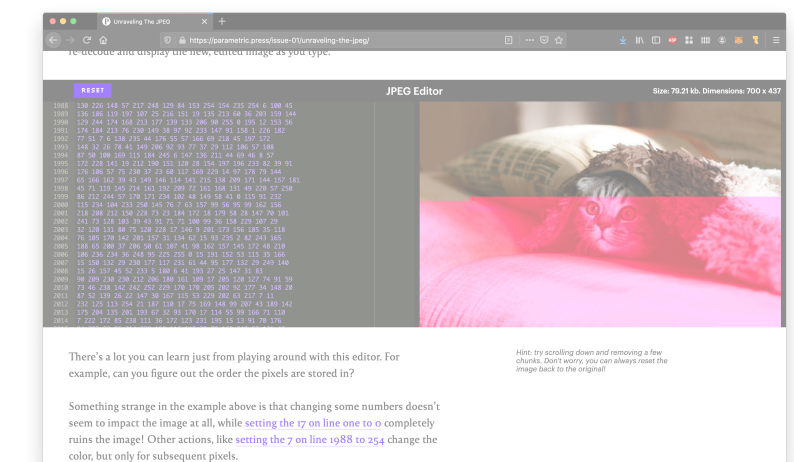
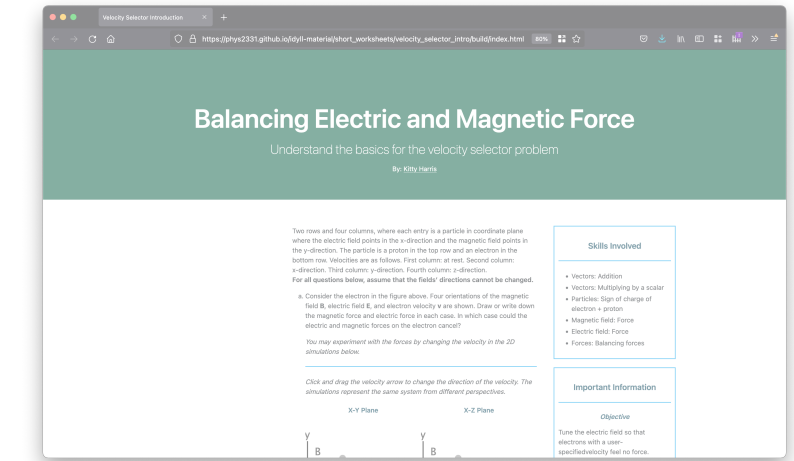
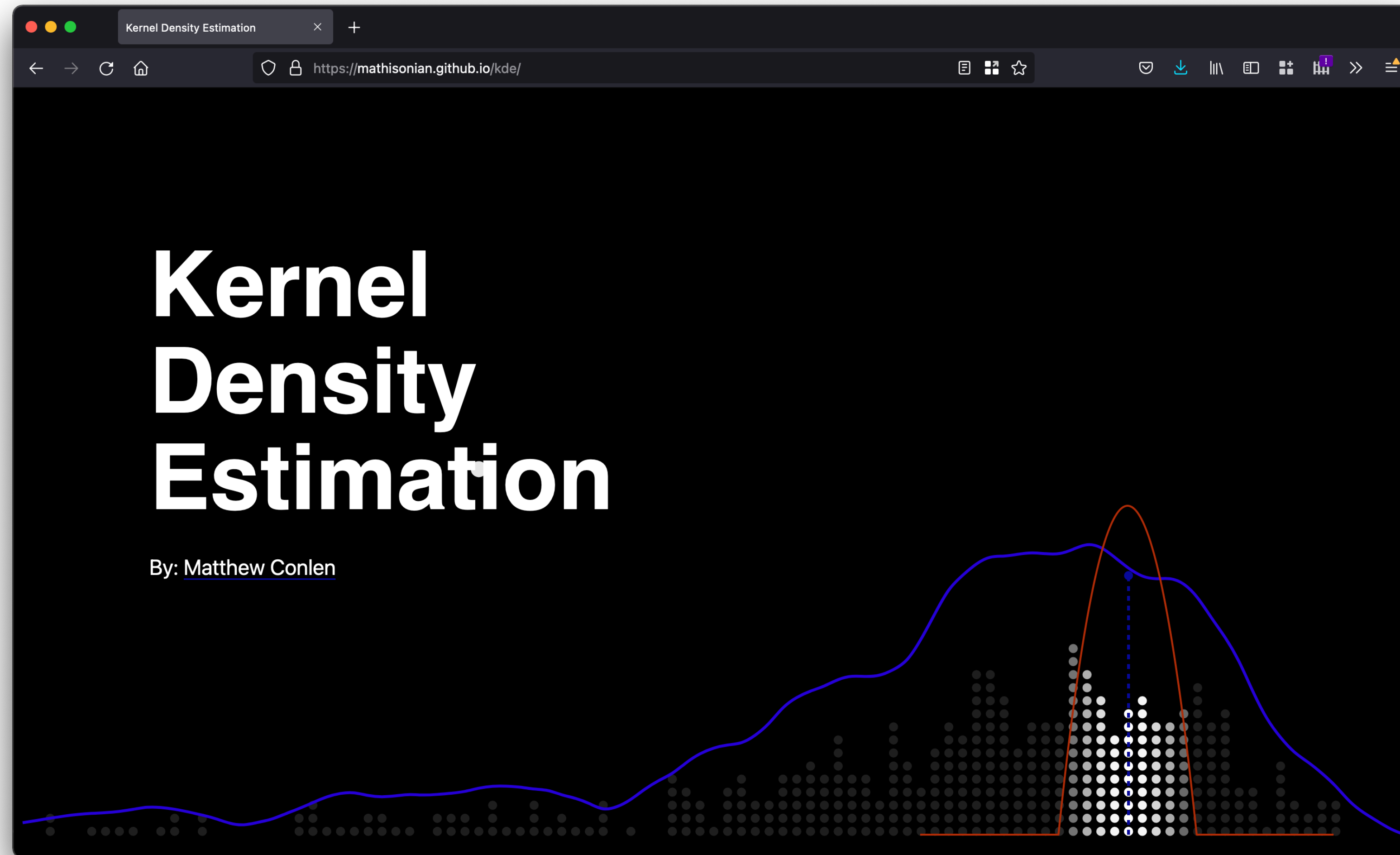
Something strange in the example above is that changing some numbers doesn't seem to impact the image at all, while [setting the 17 on line one to 0](#) completely ruins the image! Other actions, like [setting the 7 on line 1988 to 254](#) change the color, but only for subsequent pixels.

Hint: try scrolling down and removing a few chunks. Don't worry, you can always reset the image back to the original!



Unraveling the JPEG - Omar Shehata
Parametric Press (Conlen & Hohman, *VisComm '19*)

Idyll in the wild



Kernel Density Estimation

Top search result under Wikipedia, many messages saying it helped people understand the topic.

Idyll...

Seems great but...

...still requires learning and writing markup syntax

...requires use of general-purpose programming tools, e.g. to make a new post, run development server

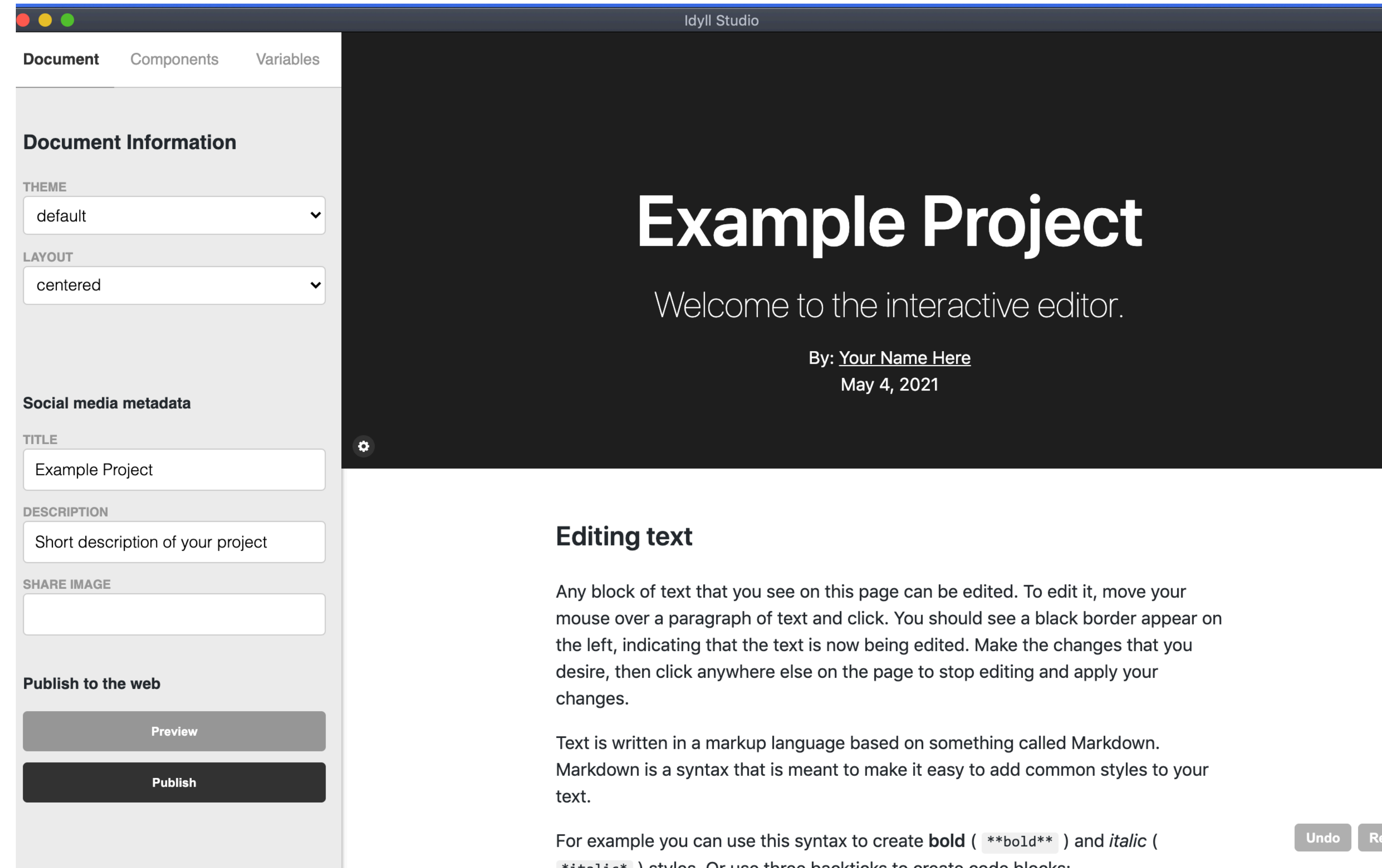
Idyll Studio

Built a **structured editor** for editing and creating Idyll programs

Reduce use of general-purpose programming tools.

Eliminate a class of syntax errors.

Reify Idyll model.



The screenshot displays the Idyll Studio interface. On the left is a sidebar with a 'Document' tab selected, containing a 'Document Information' panel with fields for 'THEME' (default), 'LAYOUT' (centered), 'Social media metadata' (TITLE: Example Project, DESCRIPTION: Short description of your project, SHARE IMAGE), and 'Publish to the web' buttons (Preview, Publish). The main area shows a preview of a document titled 'Example Project' with the text 'Welcome to the interactive editor.', 'By: Your Name Here', and 'May 4, 2021'. Below the preview is an 'Editing text' section explaining that text is editable and can be styled using Markdown syntax for bold (**bold**), italic (*italic*), and code blocks (three backticks).

Conlen, Vo, Tan, Heer, *UIST 2021*

Document Components Variables

Document Information

THEME

default



LAYOUT

centered



Social media metadata

TITLE

UIST

DESCRIPTION

Short description of your project

SHARE IMAGE

Publish to the web

Preview

Publish

Idyll Studio

Introducing UIST to the structured editor.

By: Matthew Conlen, Megan Vo, Alan Tan and Jeffrey Heer

Aug 11, 2021



Editing text

Any block of text that you see on this page can be edited. To edit it, move your mouse over a paragraph of text and click. You should see a black border appear on the left, indicating that the text is now being edited. Make the changes that you desire, then click anywhere else on the page to stop editing and apply your changes.

Text is written in a markup language based on something called Markdown.

Markdown is a syntax that is meant to make it easy to add common styles to your

Undo

Redo

Idyll Studio Architecture

Two extensions to Idyll:

Instrumentation. Take any Idyll program, inject instrumental components (text editors, component editors, insertion points)

Reflection. Allow an Idyll component to modify the Idyll program while it runs.

Architecture Overview

```
17 |
18 | ## Editing text
19 |
20 | Any block of text that you see on this page can be edited.
21 | mouse over a paragraph of text and click. You should see
22 | left, indicating that the text is now being edited. Make
23 | then click anywhere else on the page to stop editing and
24 |
25 | Text is written in a markup language based on something
26 | a syntax that is meant to make it easy to add common styles.
27 | For example you can use this syntax to create bold (
28 | italic ) styles. Or use three backticks to create code
```

Idyll markup

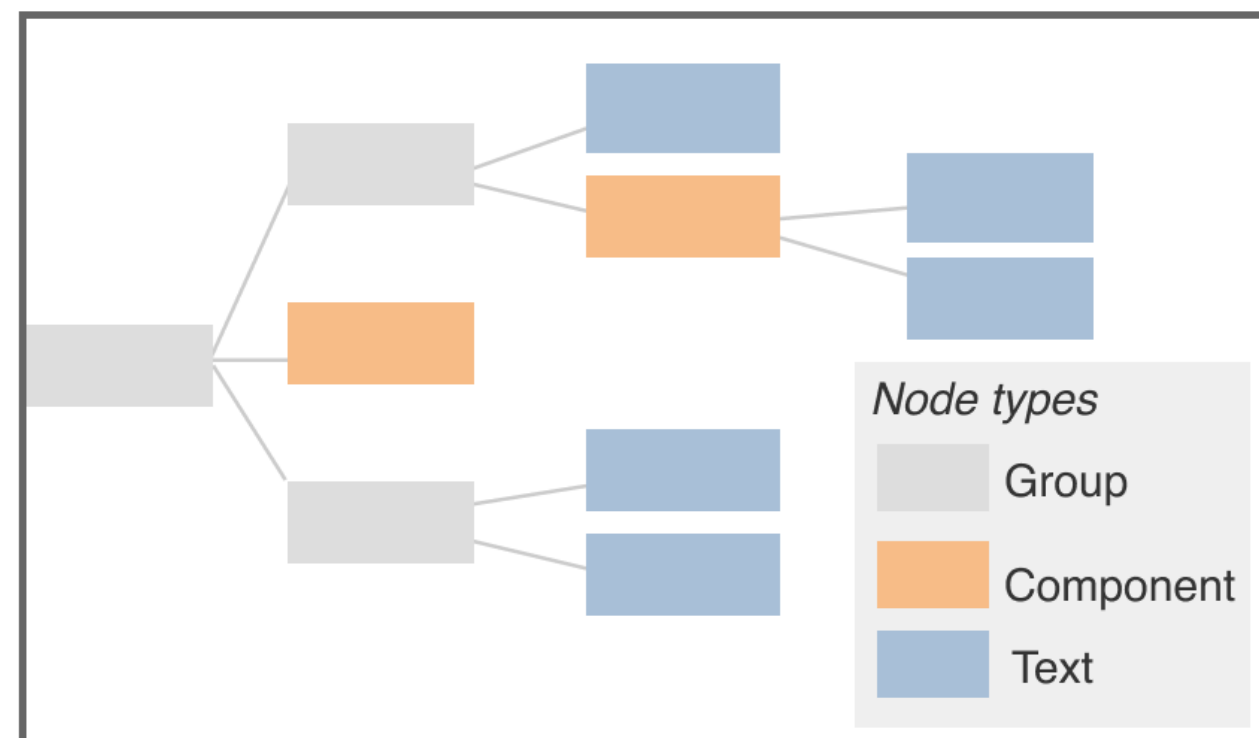
Architecture Overview

```
17 |
18 | ## Editing text
19 |
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Idyll markup

is compiled to ↓

AST structure



Architecture Overview

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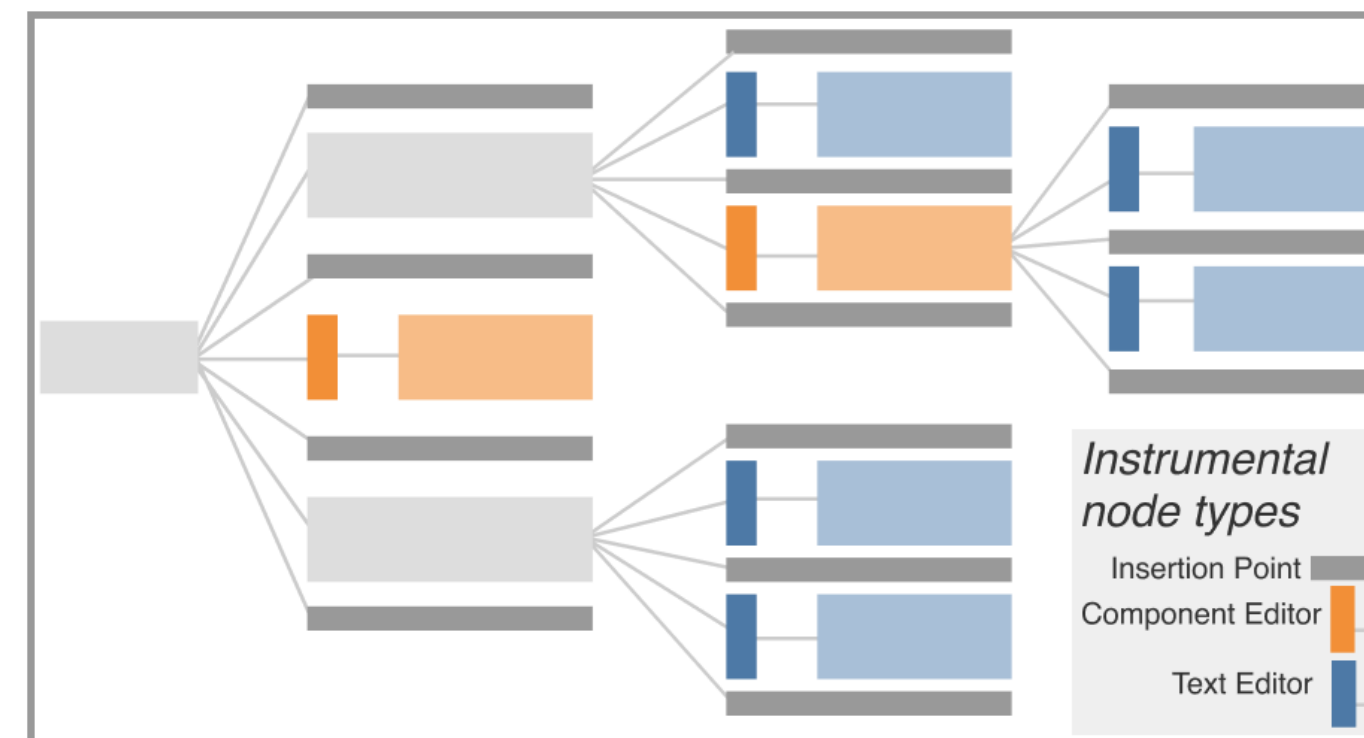
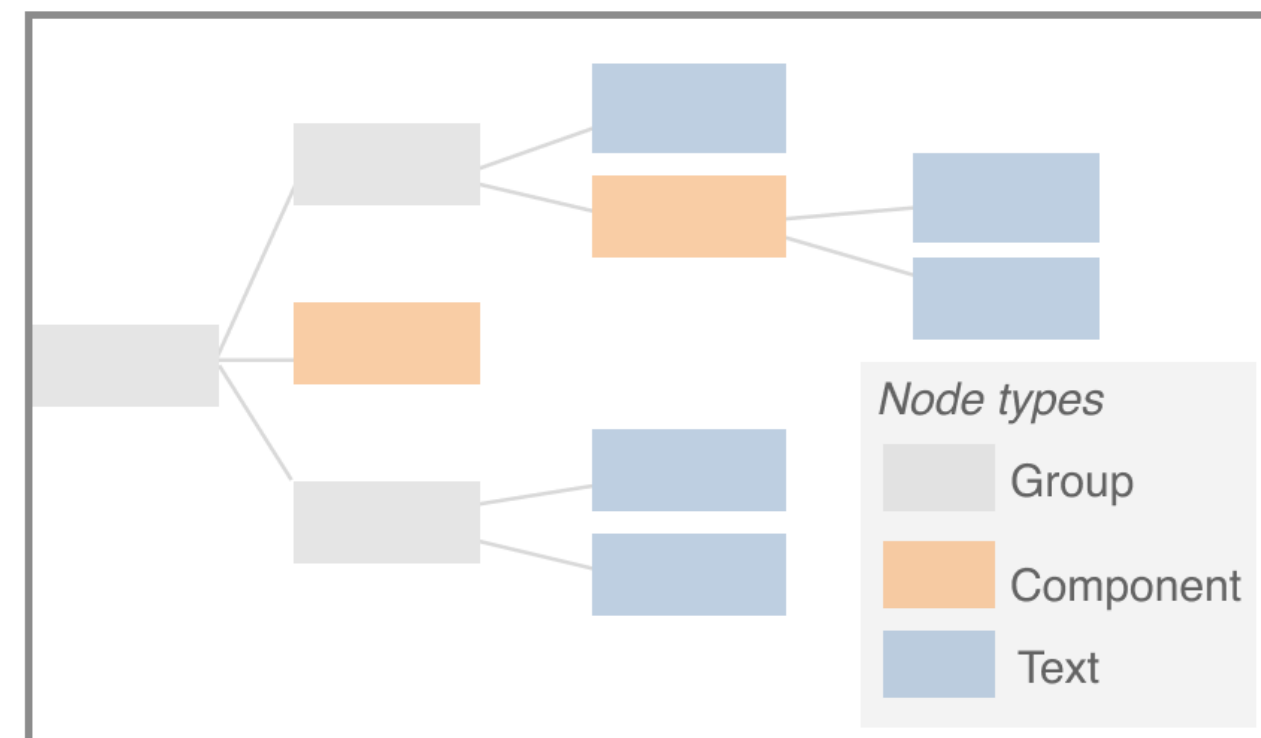
Idyll markup

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Instrumented AST



Architecture Overview

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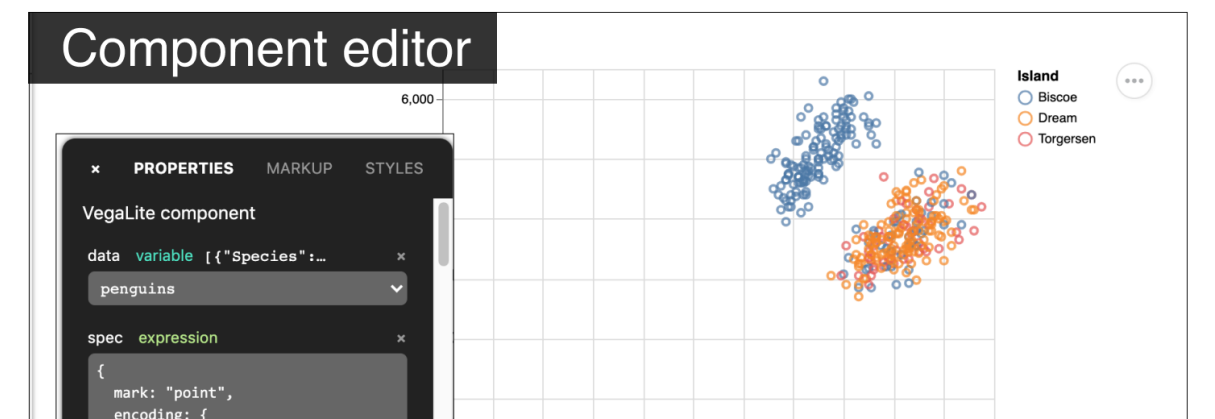
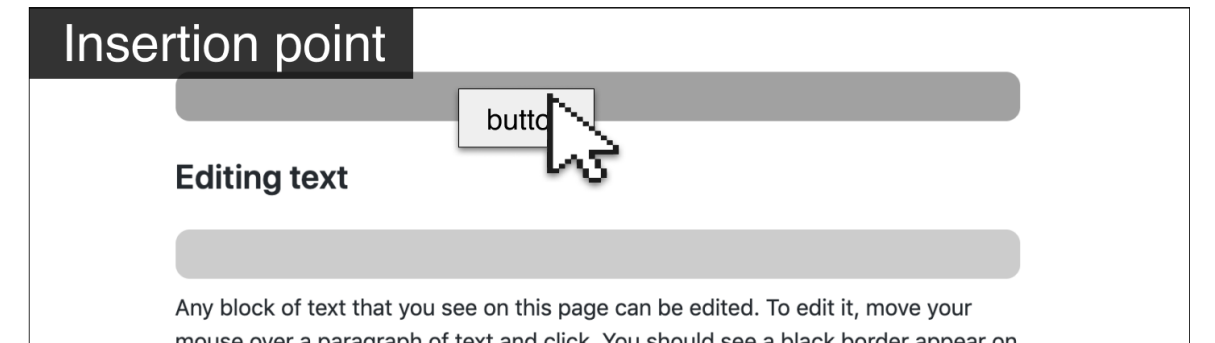
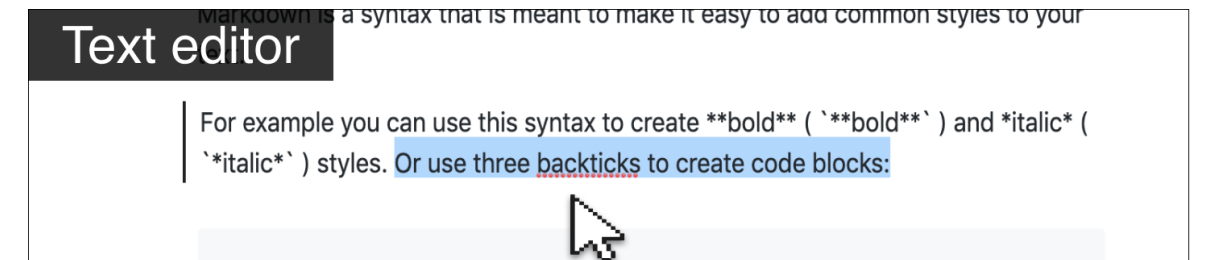
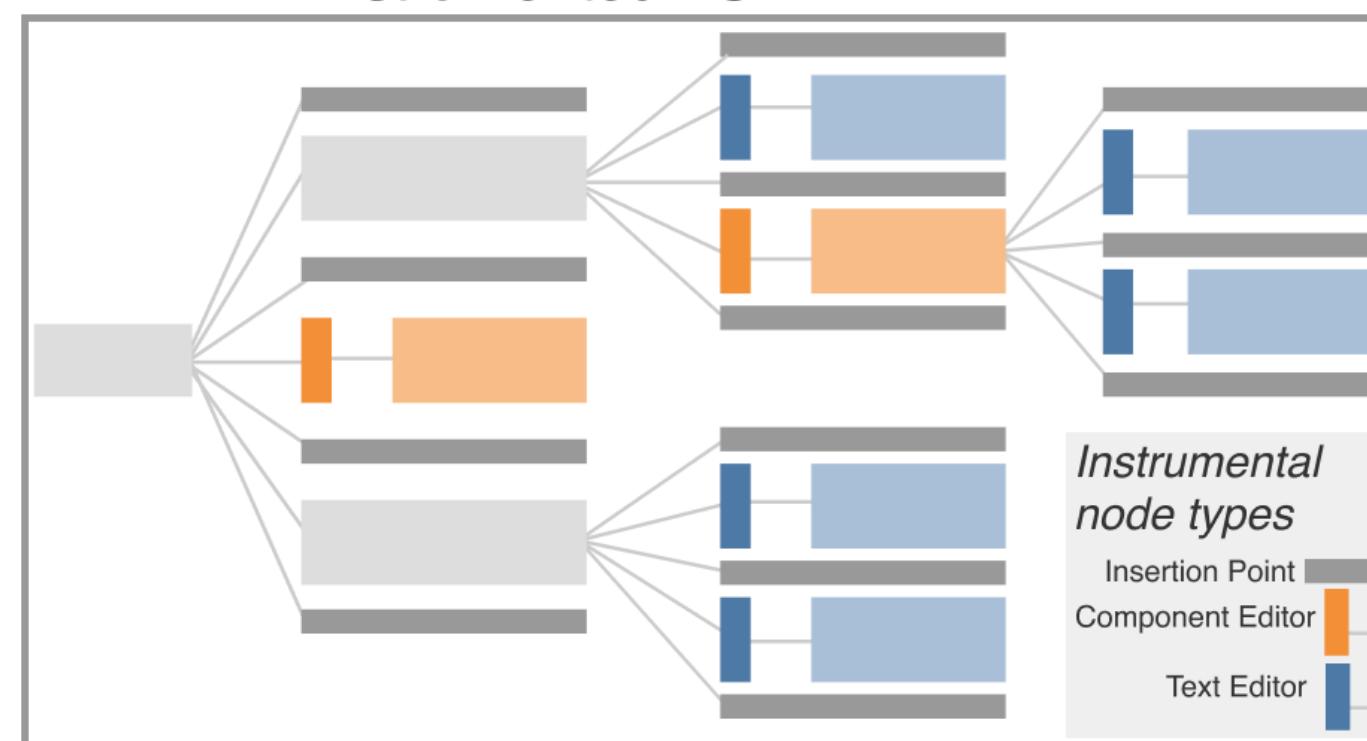
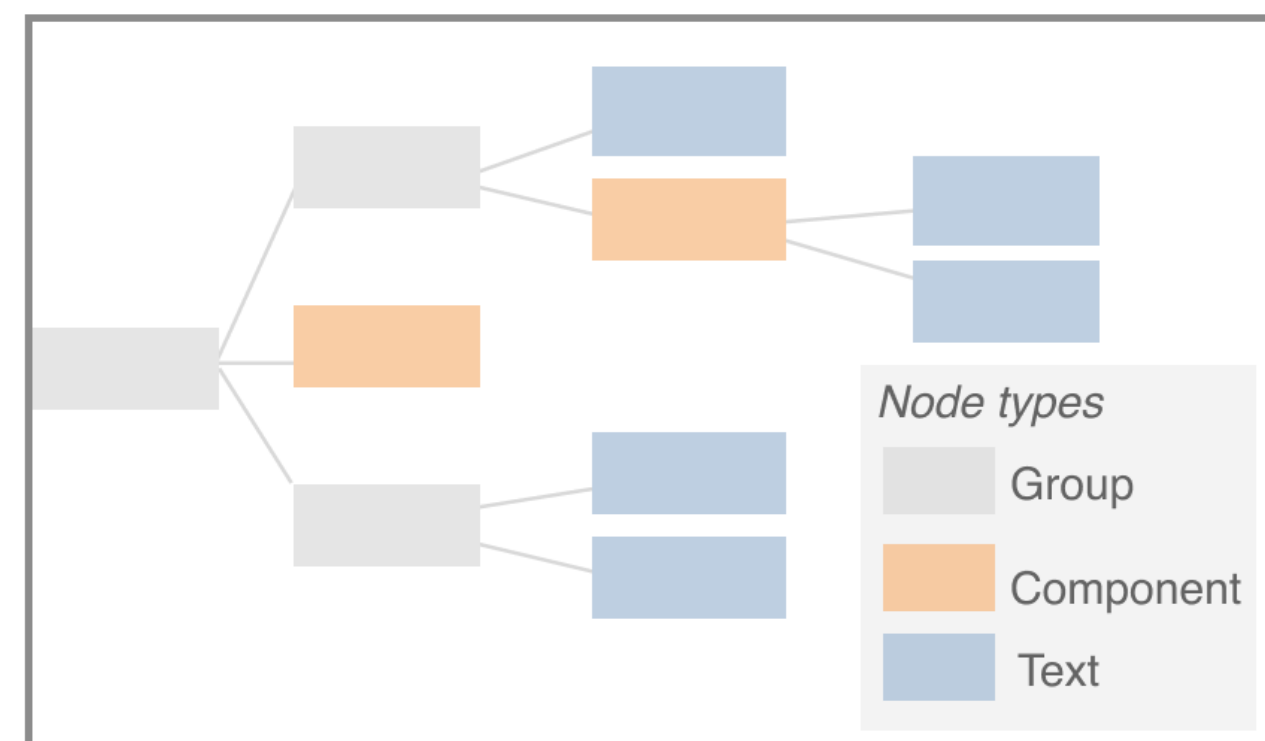
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Instrumented AST

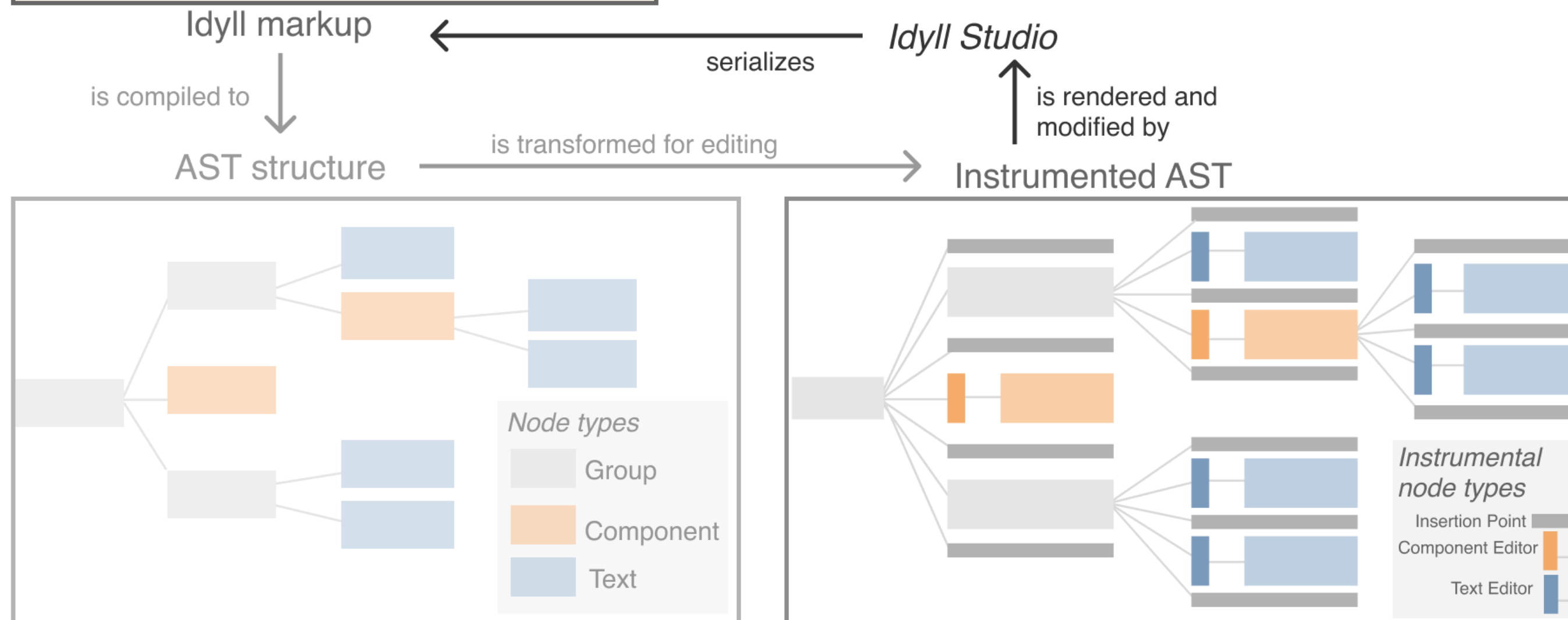
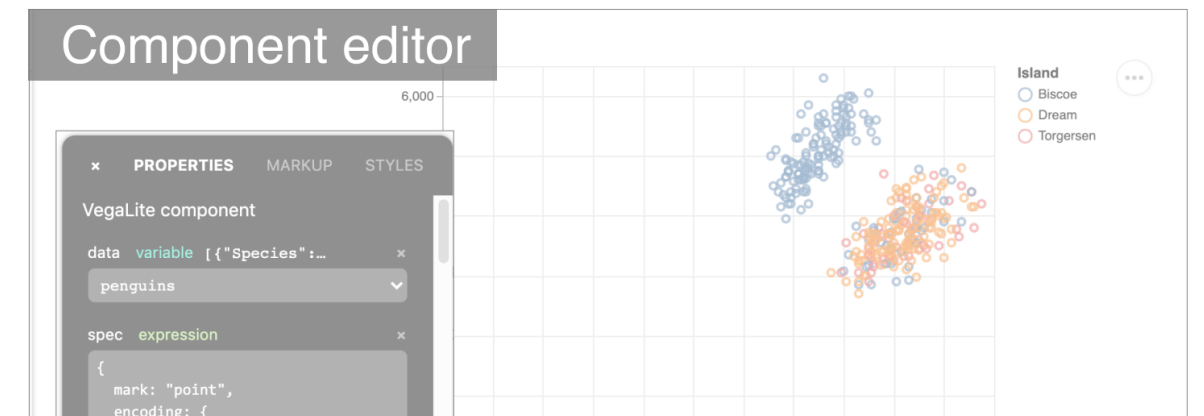
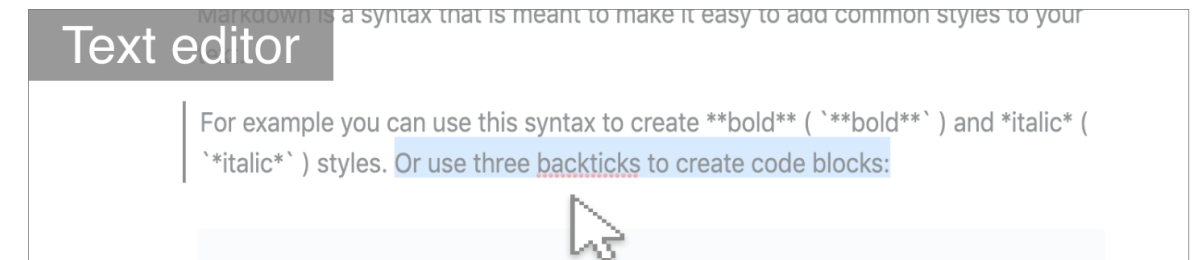
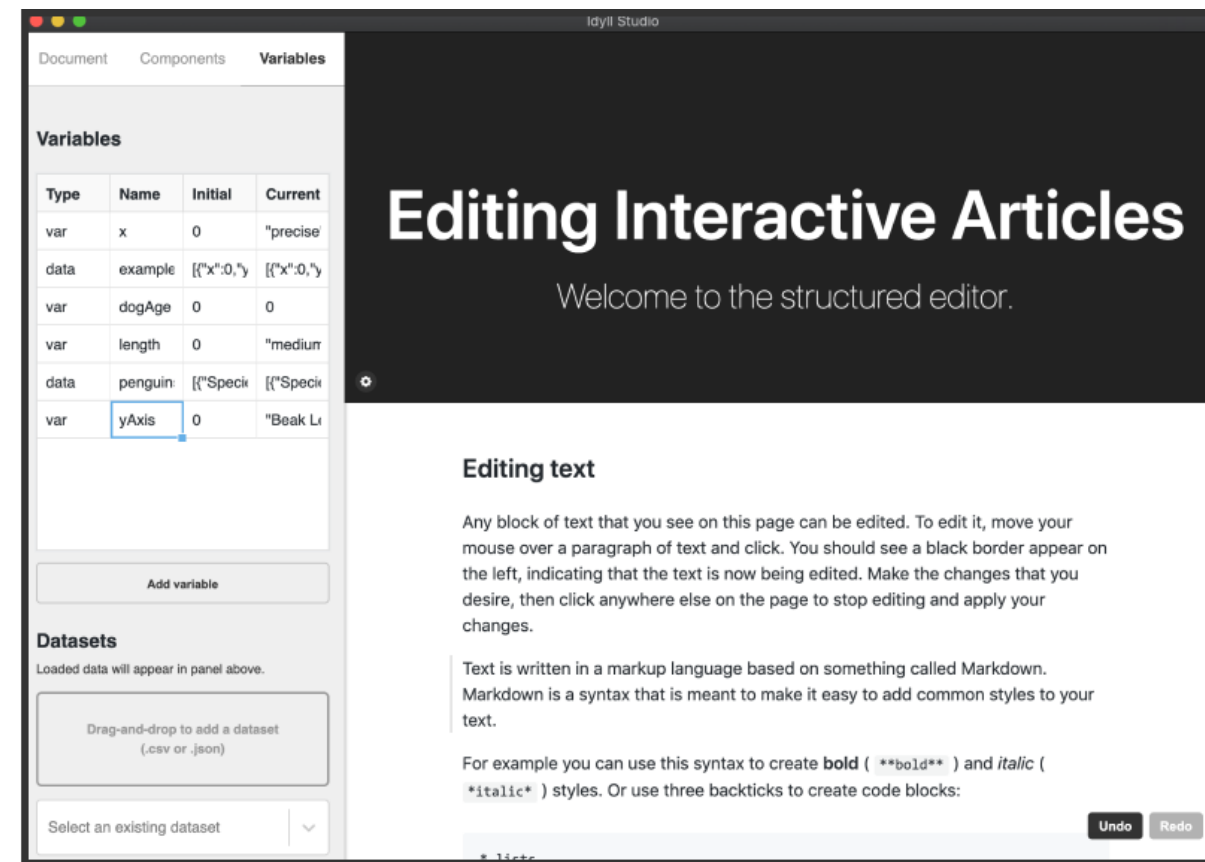


Architecture Overview

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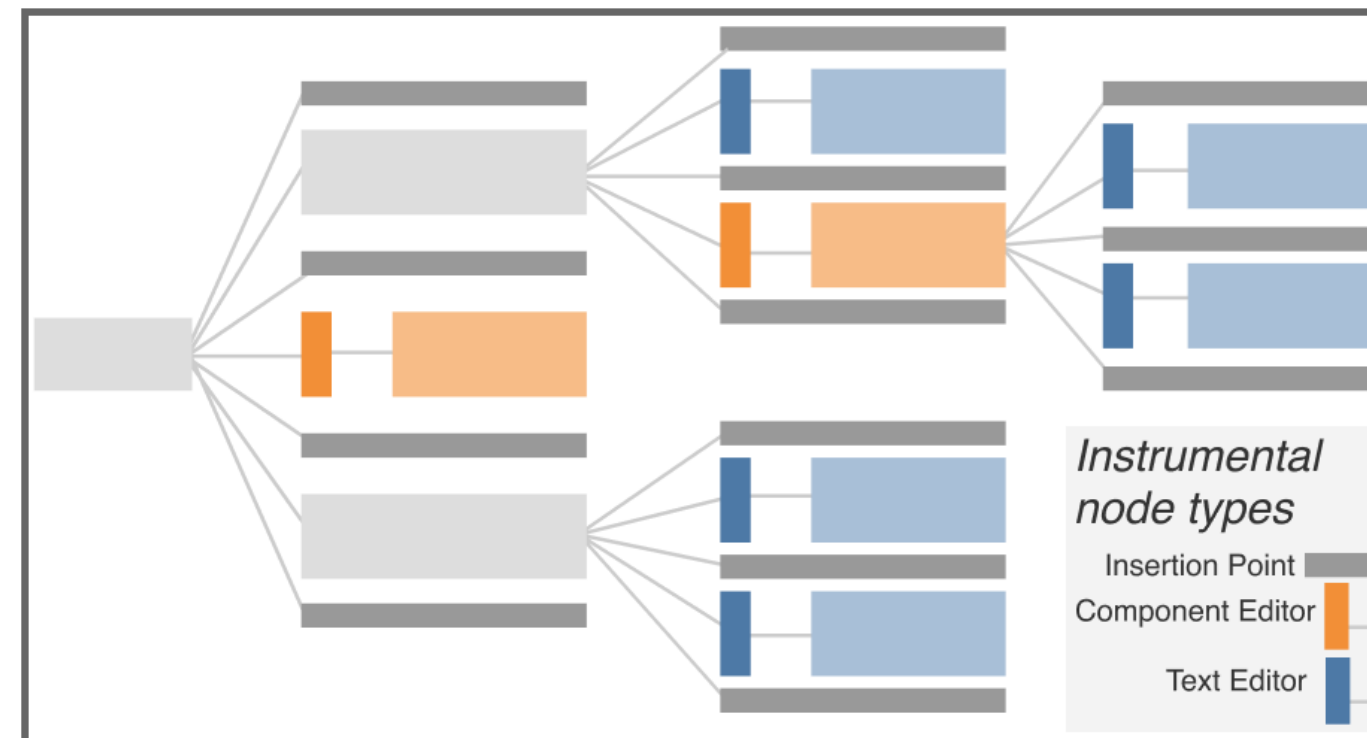
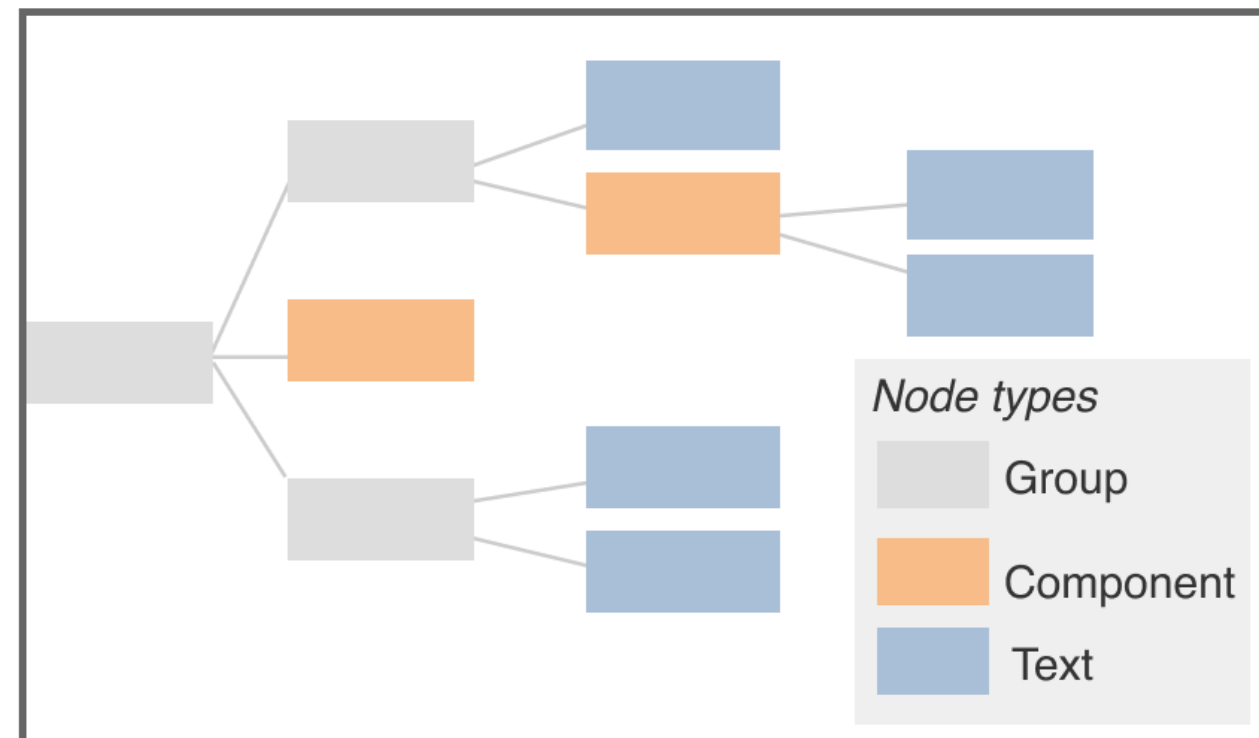
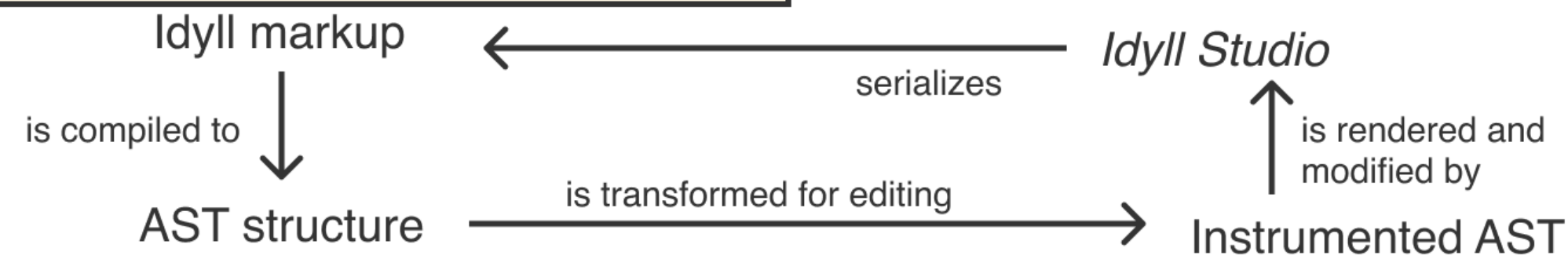
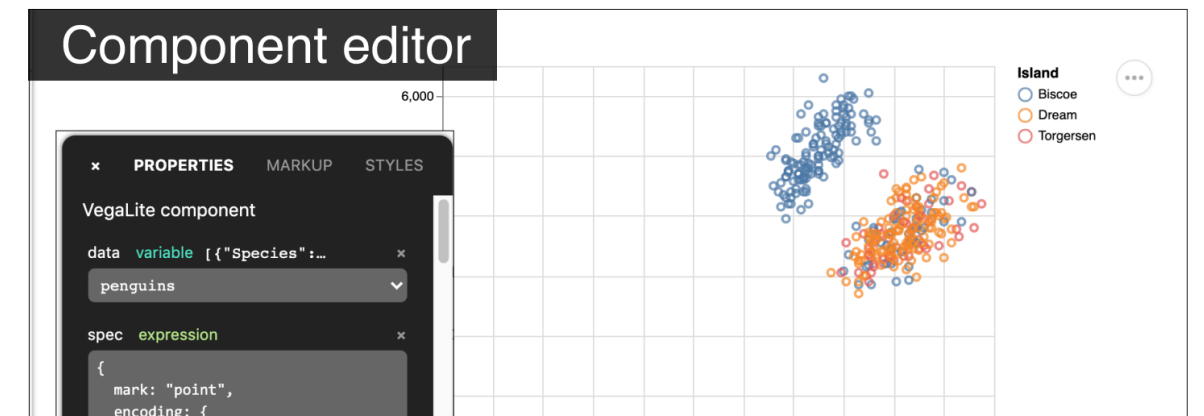
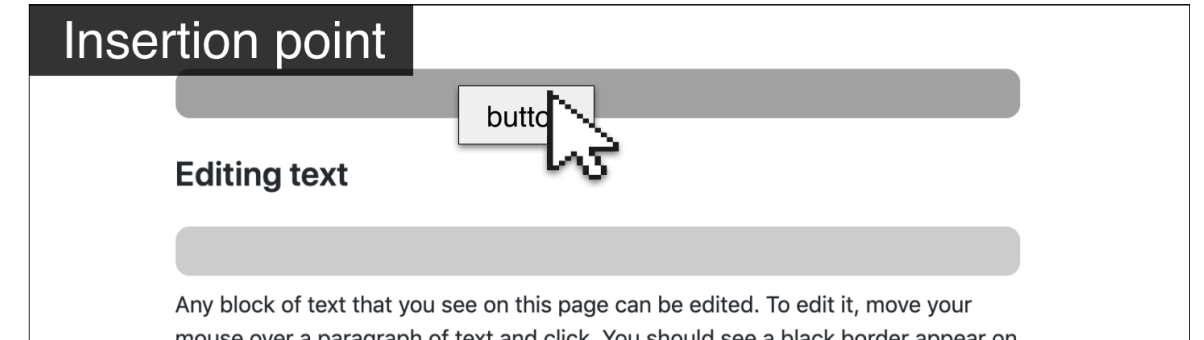
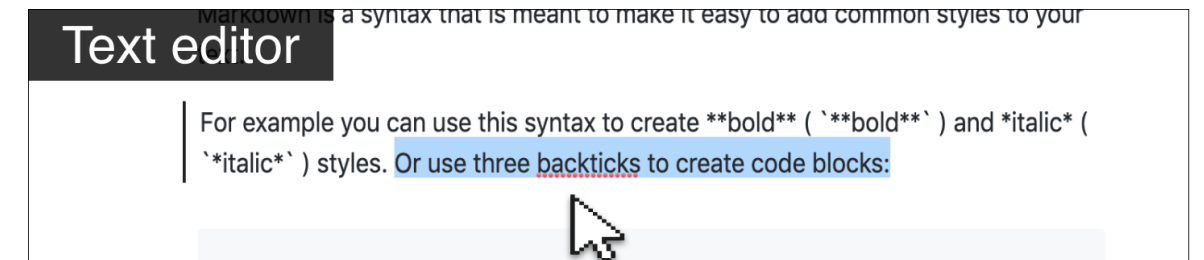
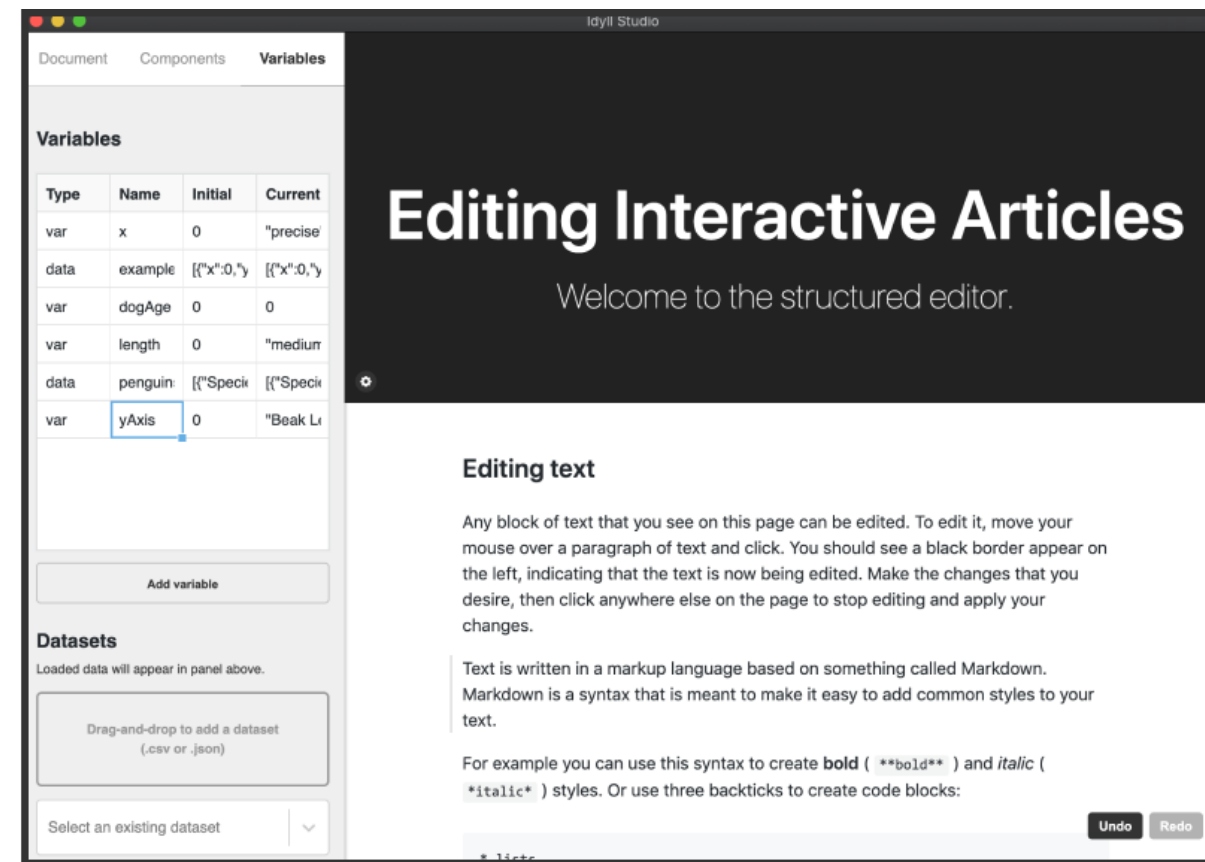


Architecture Overview

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26 For example you can use this syntax to create bold ( **bold** ) and italic ( *italic* ) styles. Or use three backticks to create code blocks:
27
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```



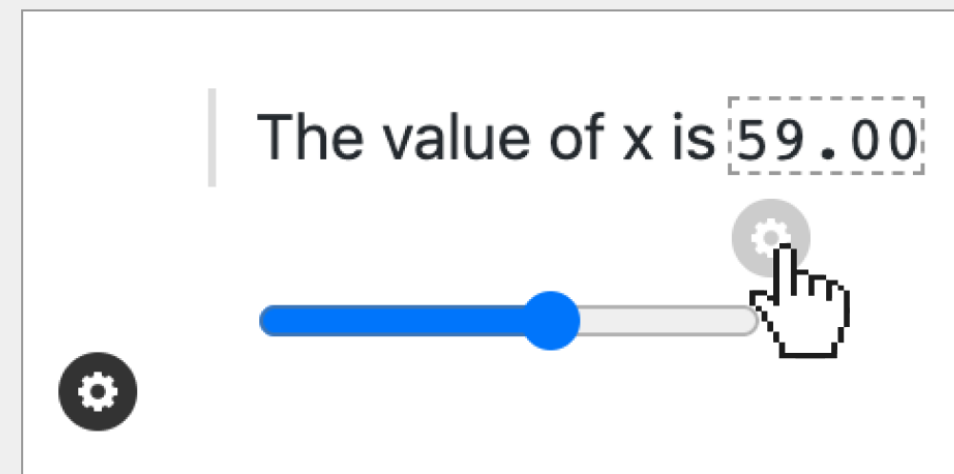
Idyll Studio Evaluation

18 Participants; 10 minute tutorial; 30 minutes to complete 6 tasks

Interaction

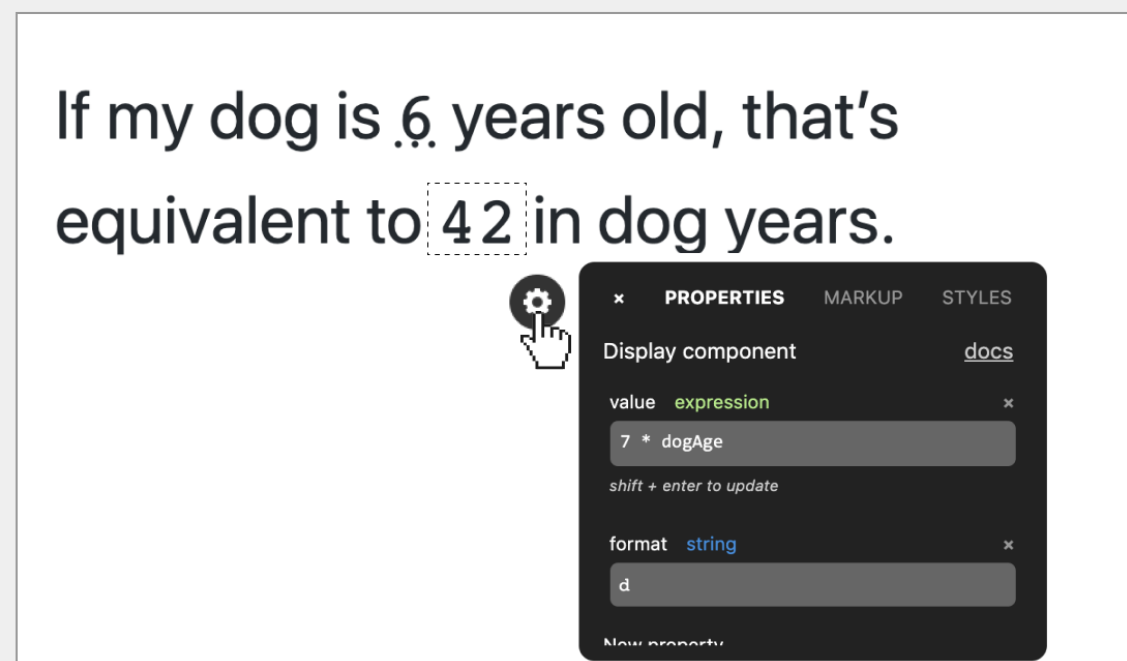
Interactivity with Variables Basic

Prompt. Create a new variable. Add a *Slider* to the page which modifies the value of that variable; add a component that displays the value of the variable.



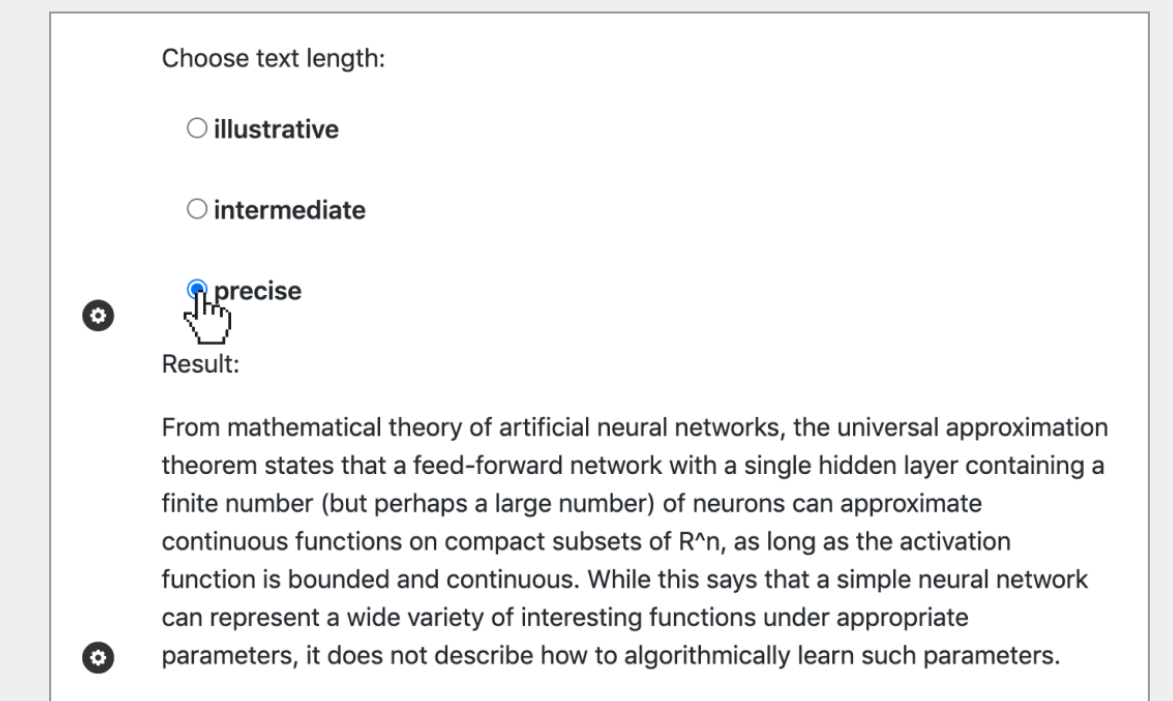
Dog Years Calculator Intermediate

Prompt. Create an interactive calculator in the article text that calculates a dog's age in *dog years*.



StretchText Advanced

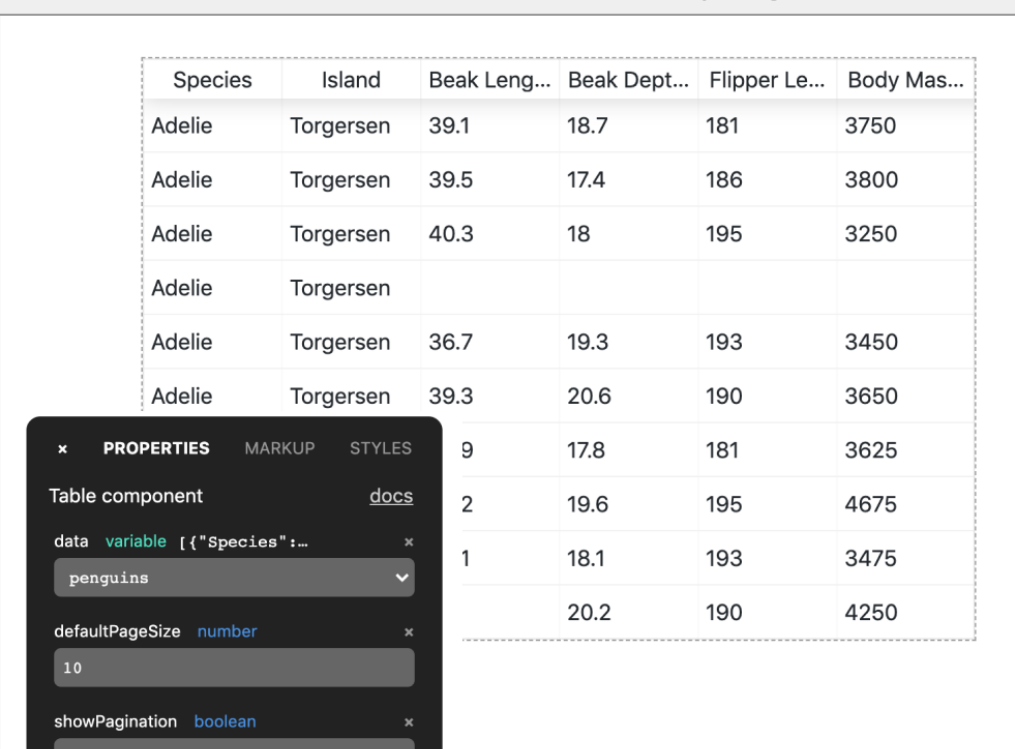
Prompt. Use a *Switch* component to implement dynamic text that expands to different levels-of-detail based on reader input.



Data-driven

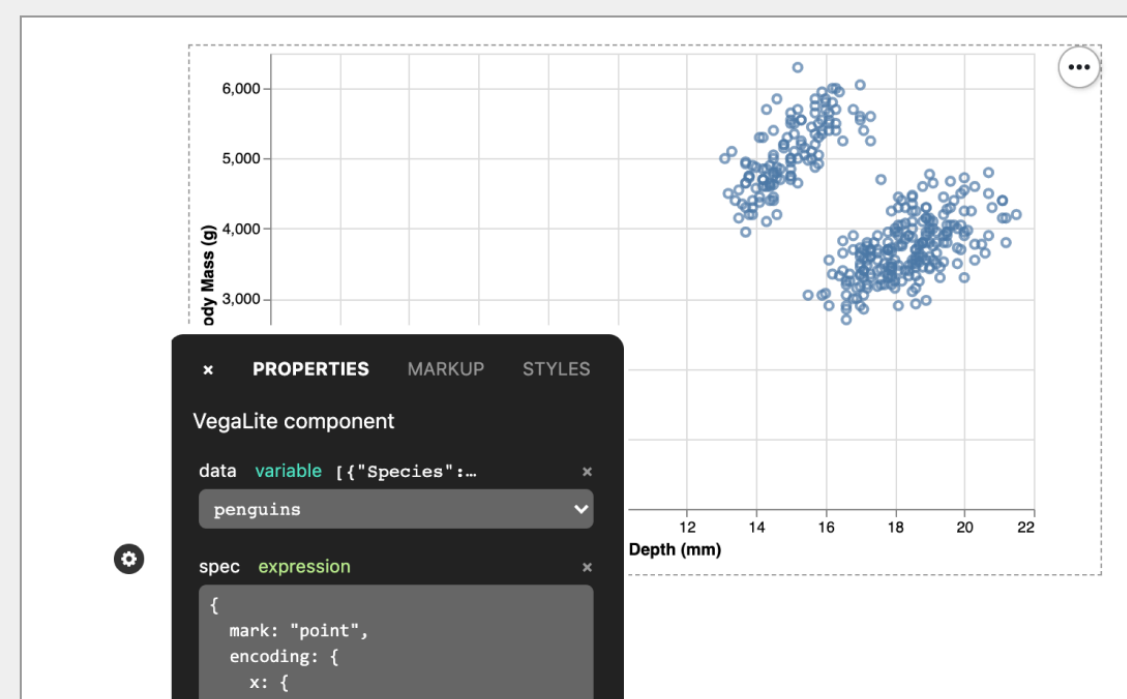
Importing & Displaying Data Basic

Prompt. Import a provided tabular data file (penguins.json), import it into *Idyll Studio*. Add a *Table* to the article and have it display the data.



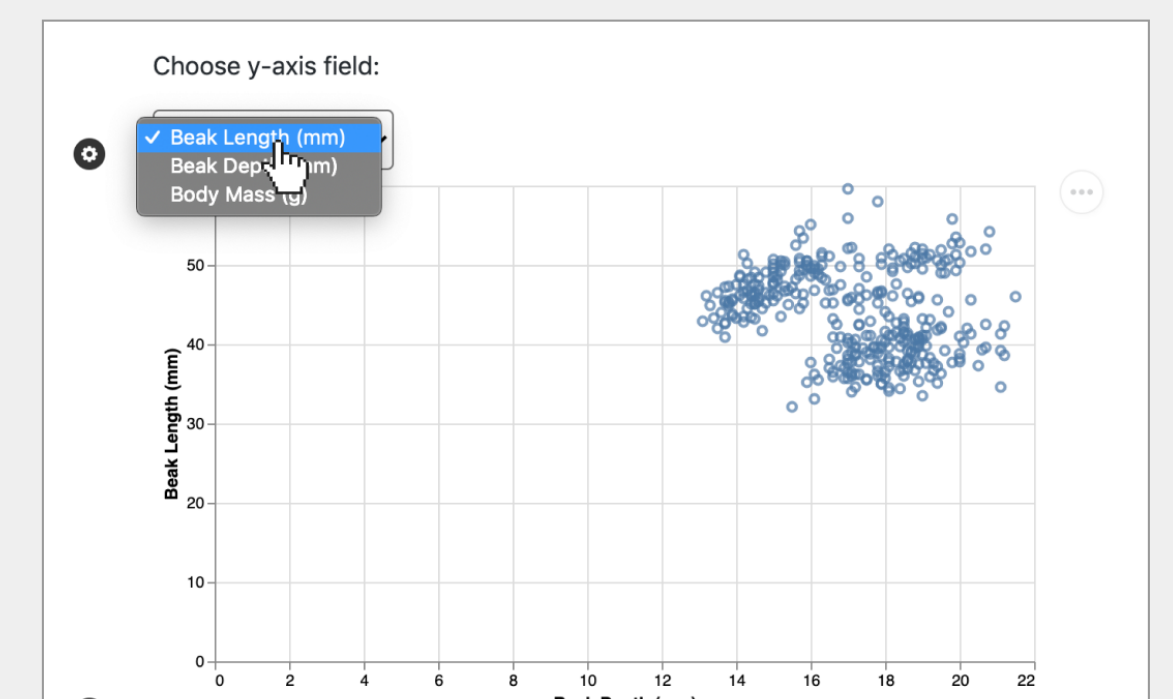
Data Visualization Intermediate

Prompt. Create a static scatter plot that displays any two quantitative fields from the *penguins.json* dataset.



Interactive Visualization Advanced

Prompt. Add a dropdown element above the scatter plot that lets a reader select which field to show on the chart's y-axis.



Idyll Studio Findings

1. The interface enabled users to **rapidly create designs with less stress.**

2. But some users struggled to synthesize multiple concepts. Others **needed time to understand the reactive model.**

3. The interface **should provide more visual feedback**, promote experimentation, provide documentation on demand, and have **guardrails to prevent likely mistakes.**

4. The interface empowered users and **provided better support to less technical users compared to existing tools.**

	Role	Tech.	I1	D1	I2	D2	I3	D3
P1	comp. biologist	4.2	y	y	y	y	y	y
P2	programmer	4.2	y	y	y	y	y	y
P3	hci researcher	3.8	y	y	y	y	y	y
P4	vis. practitioner	3.7	y	y	y	y	y	y
P5	hci researcher	3.5	y	y	y	y	y	y
P6	journalist	3.4	y	y	y	y	y	y
P7	hci researcher	3.4	y	y	y	y	y	y
P8	lab manager	3.4	y	y	y	y	y	y
P9	programmer	3.2	y	y	y	y	y	y
P10	vis. practitioner	2.9	y	y	y	y	y	y
P11	editor	2.9	y	y	y	y	y	y
P12	cs/journ. student	2.5	y	y	y	y	y	y
P13	data scientist	2.5	y	y	y	y	n	n
P14	analyst	2.3	y	y	y	y	n	n
P15	designer	2.3	y	y	y	y	n	n
P16	writer	1.8	y	y	y	n	n	n
P17	ux researcher	1.8	y	y	y	y	y	y
P18	designer	1.3	y	y	y	y	n	n

Design Prompt

Design Prompt ELECTION NIGHT

You want to keep the public as informed as possible of the status of the 2024 presidential election as it happens.

May want to convey:

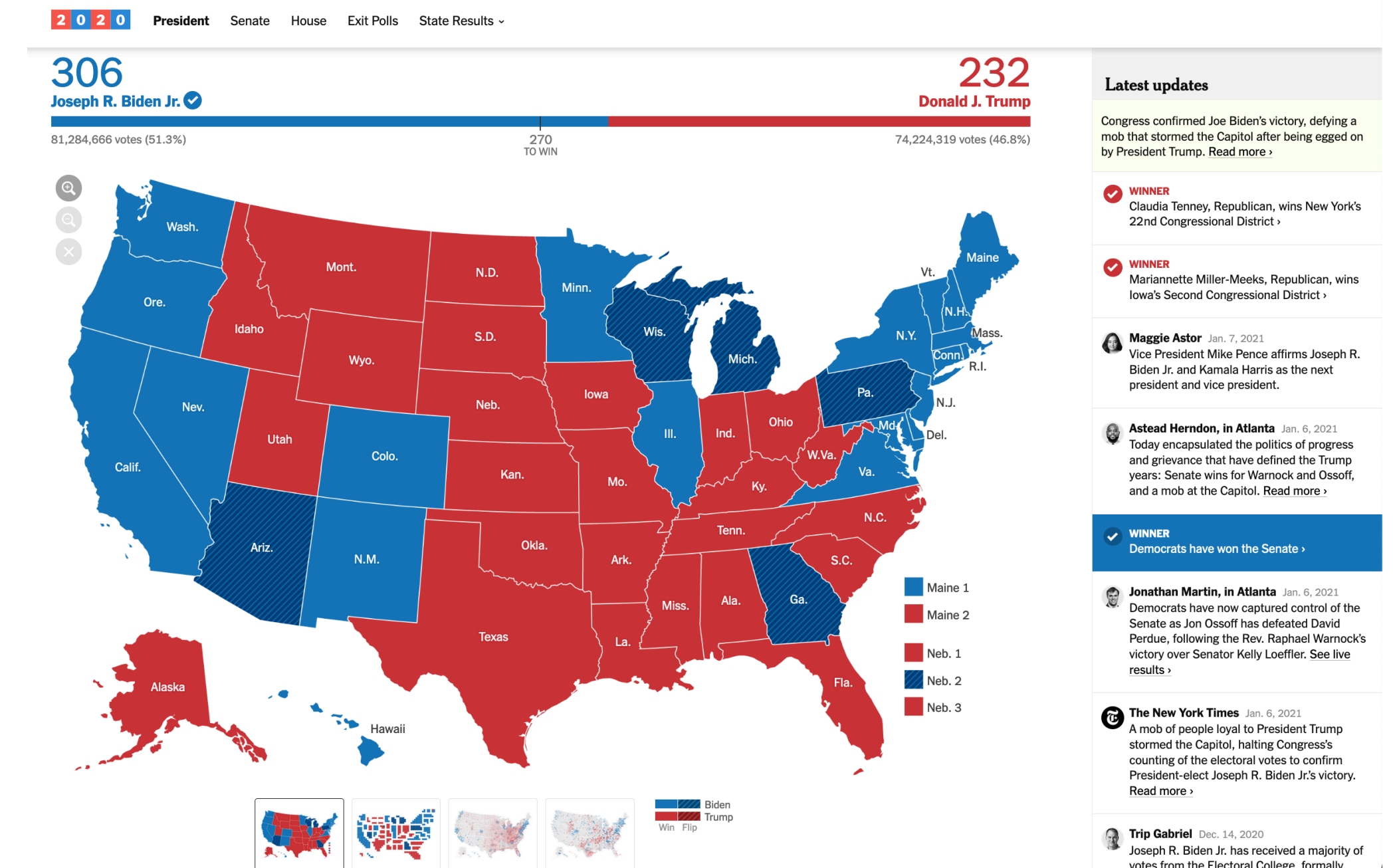
Current snapshot

Likely outcomes

Awareness of uncertainty

Historical context

Any unusual circumstances
(e.g. delayed returns)



Design Prompt ELECTION NIGHT

Input Data

Vote counts

candidate, state, method, timestamp, # votes

Race calls

candidate, state, timestamp

Constraints

Near real time

Never seen the data before

Data may contain errors

Should not erode public trust

Design Prompt ELECTION NIGHT

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**How would you
visualize this?**

**What data would
you use?**

Design Prompt ELECTION NIGHT

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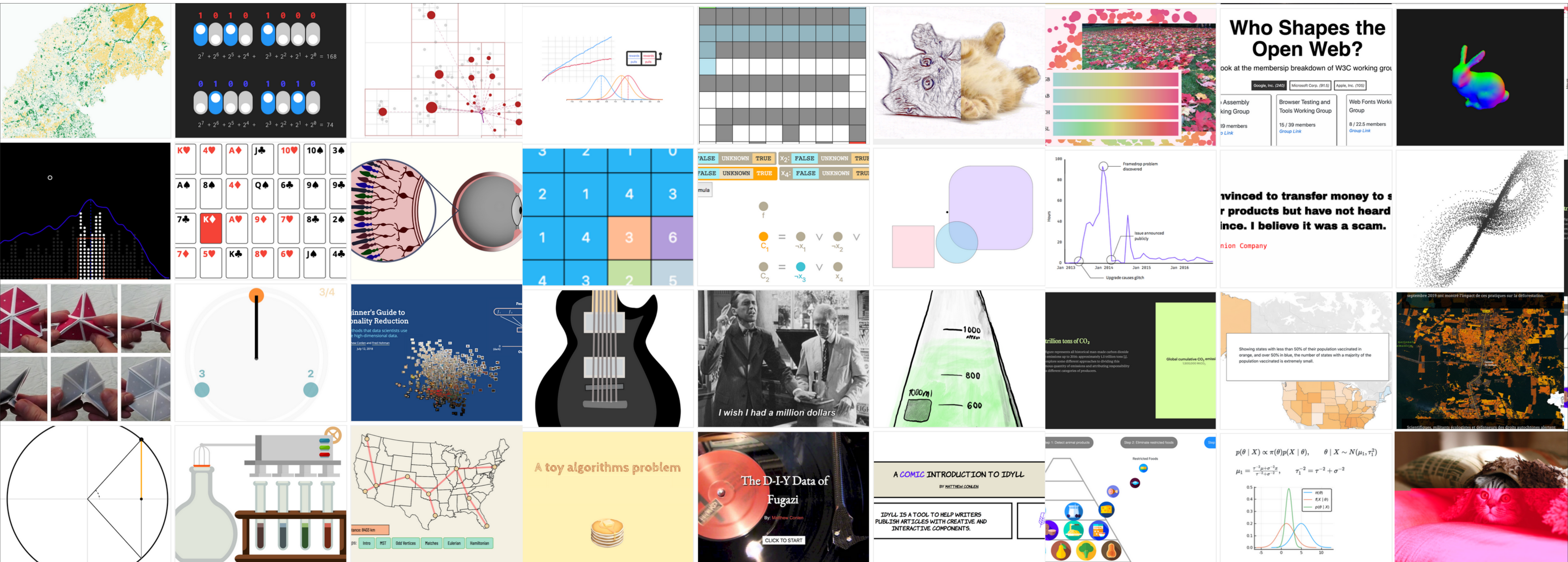
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Awareness of uncertainty

Historical context

Any unusual circumstances

Thank you! Questions?



Contact:

mpconlen@gmail.com
[@mathisonian](https://twitter.com/mathisonian)