Narrative Visualization

DSC 106: Data Visualization

Jared Wilber

UC San Diego

Announcements

Lab 7 (Scrollytelling) out, due Monday

Final Project Proposal (and groups) due Monday

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Lab 7 (Scrollytelling) out, due Monday

Final Project Proposal (and groups) due Monday

(More on the final project at the end of lecture)

About Project 3 Grading

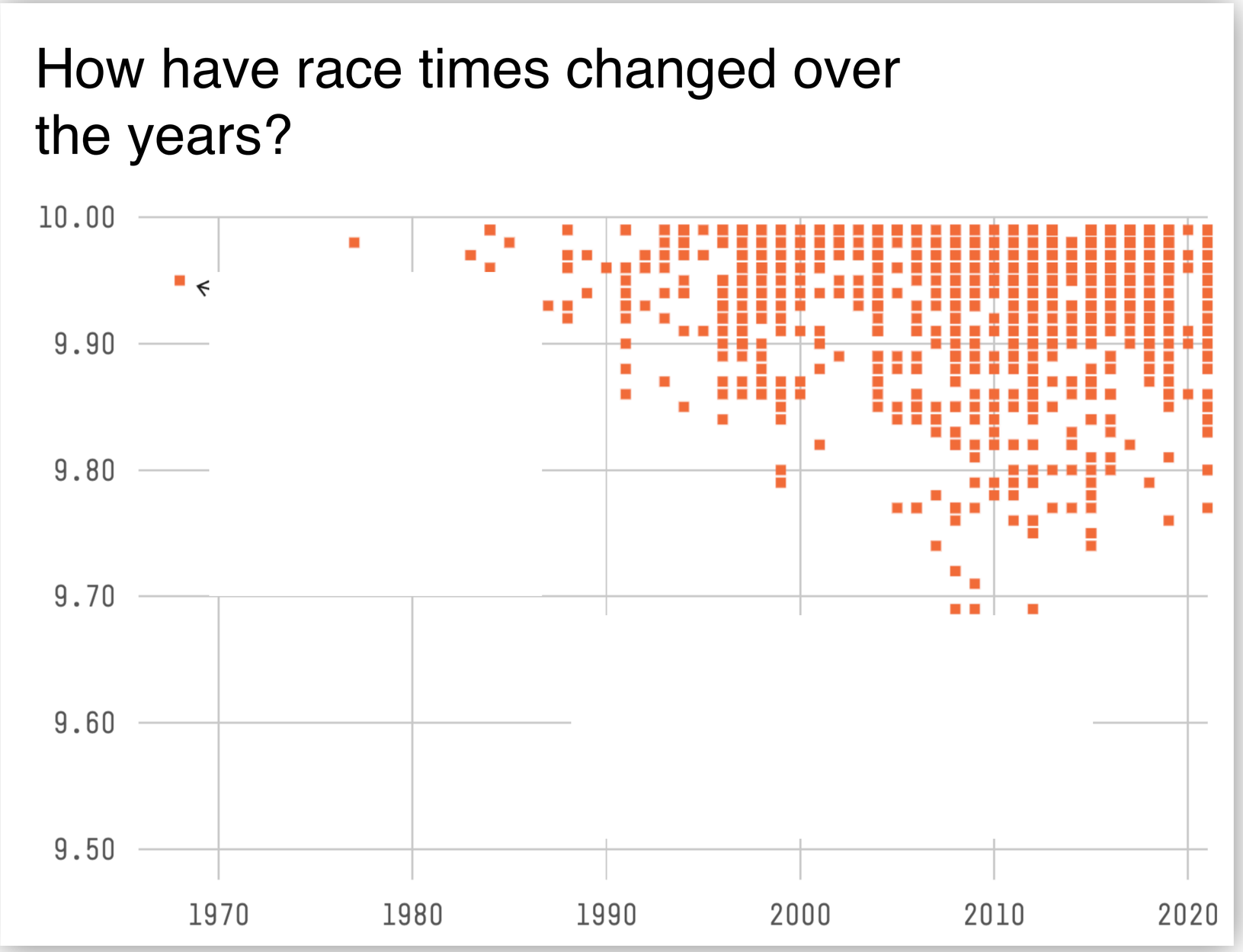
Going above and beyond (e.g. polish, creative encoding, storytelling) = extra points.

Mistakes (overplotting, ineffective encodings) = minus points.

7/10 means that you made a good visualization with no issues.

10/10 means that you made an outstanding visualization that could be published in the news / a scientific paper.

7/10: Solid visualization with no issues.

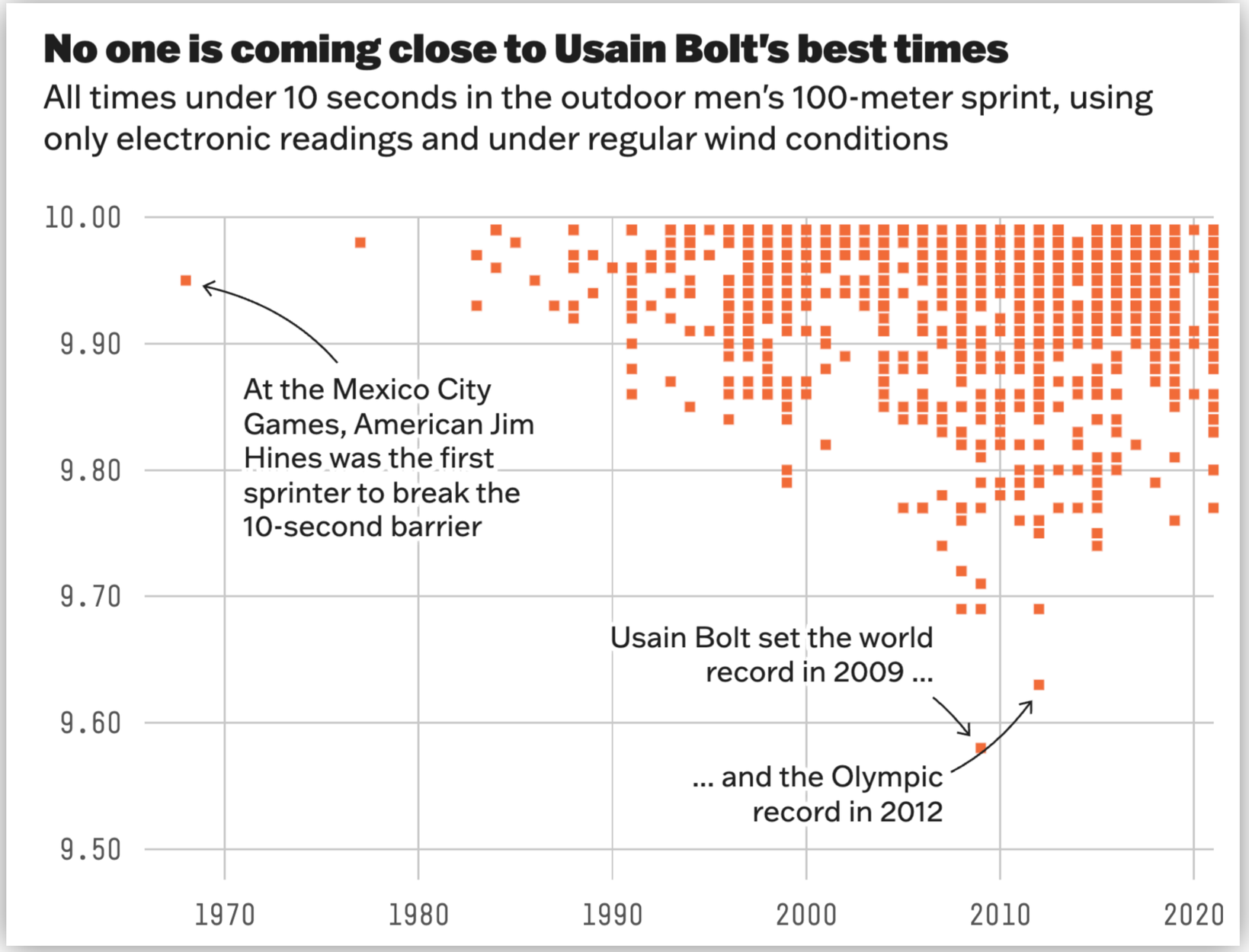


7/10: Solid visualization with no issues.

10/10: Publication-ready visualization:

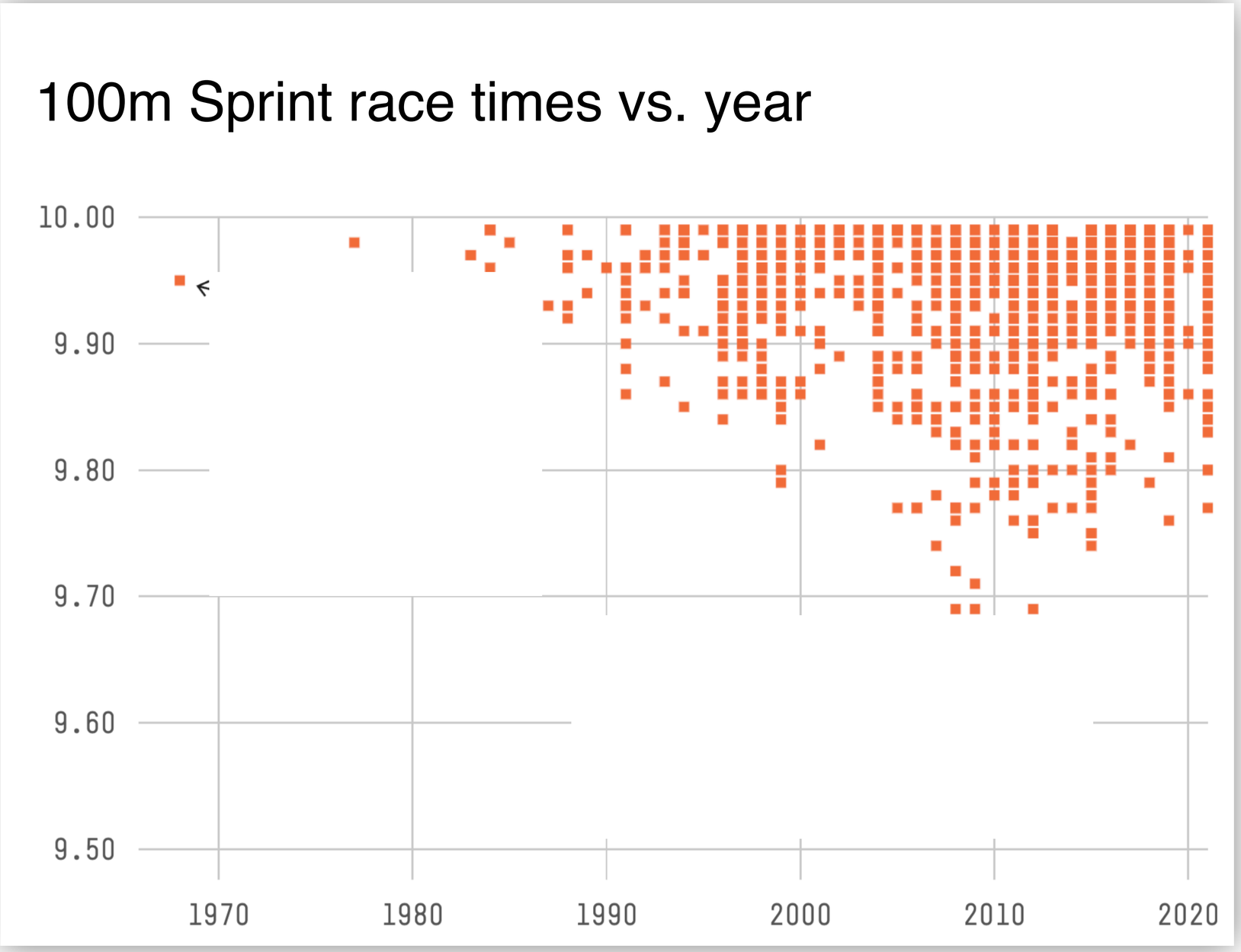
Title states most important takeaway.

Annotations tell story.



9/10: Solid visualization with no issues.

6.5/10: Title not a research question or an interesting takeaway



Interactive Articles

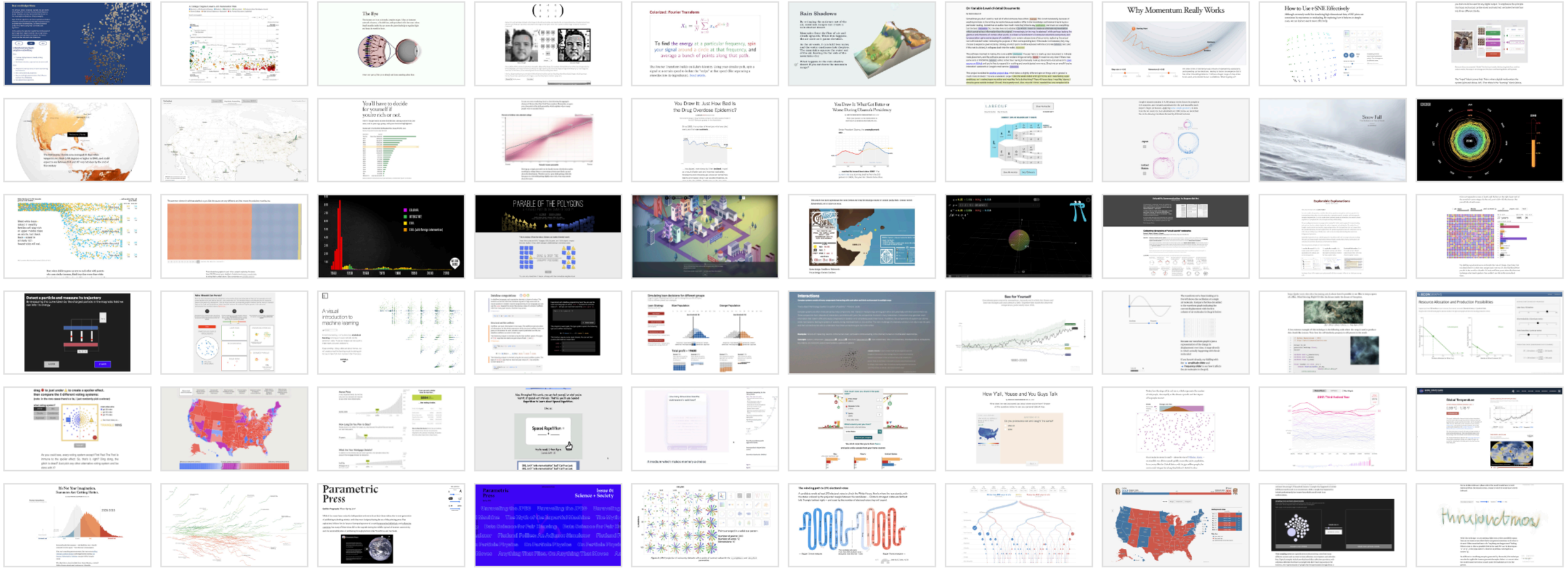
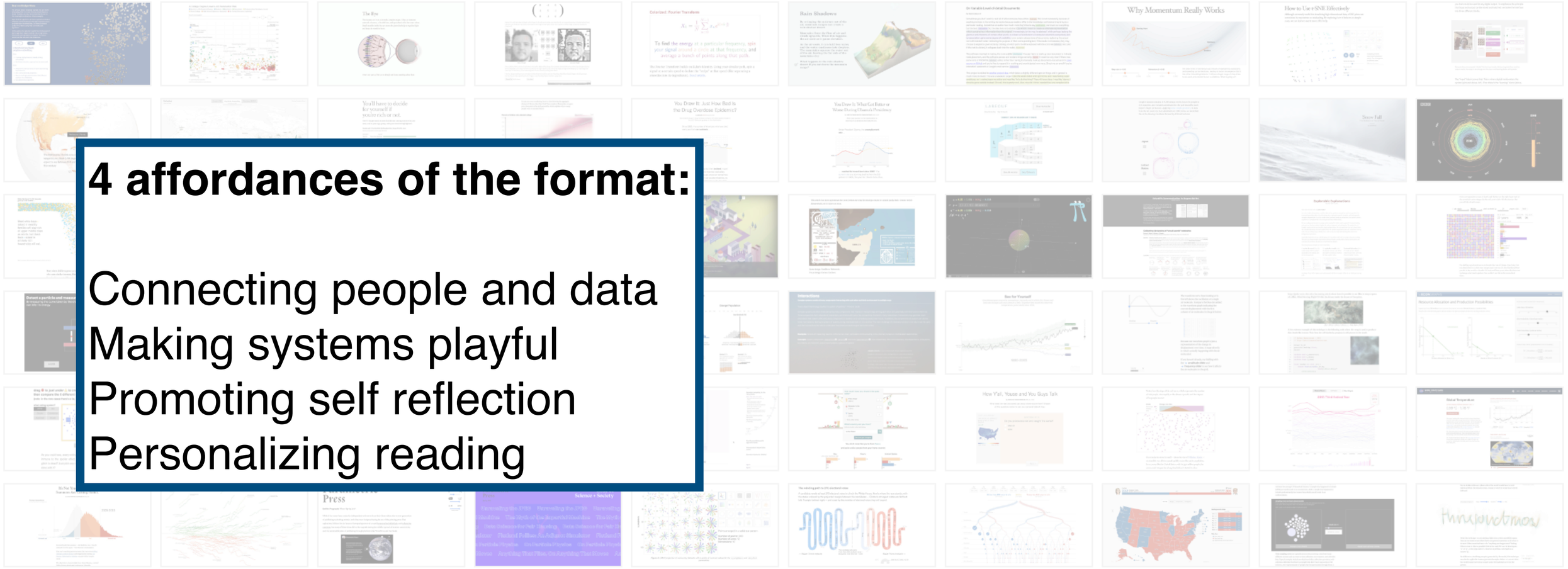


FIGURE 1: **Exemplary Interactive Articles From Around The Web.** Select an article for more information.

https://distill.pub/2020/communicating-with-interactive-articles/



4 affordances of the format:

Connecting people and data
Making systems playful
Promoting self reflection
Personalizing reading

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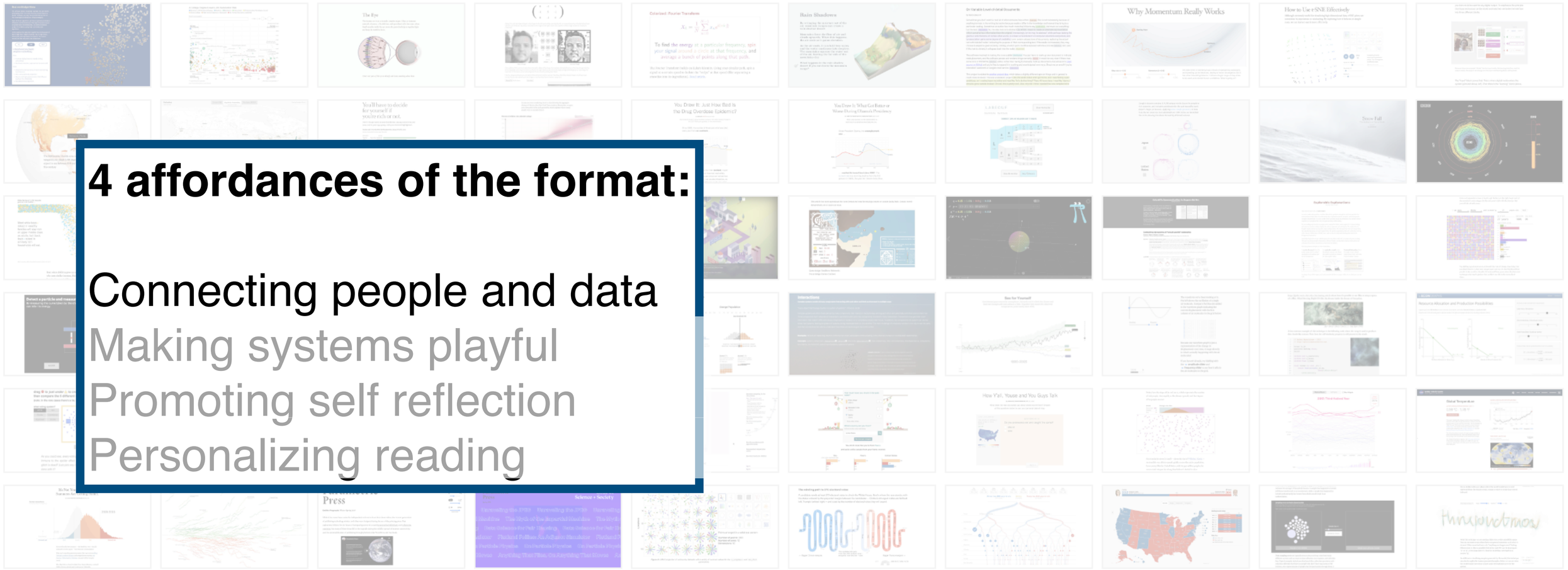

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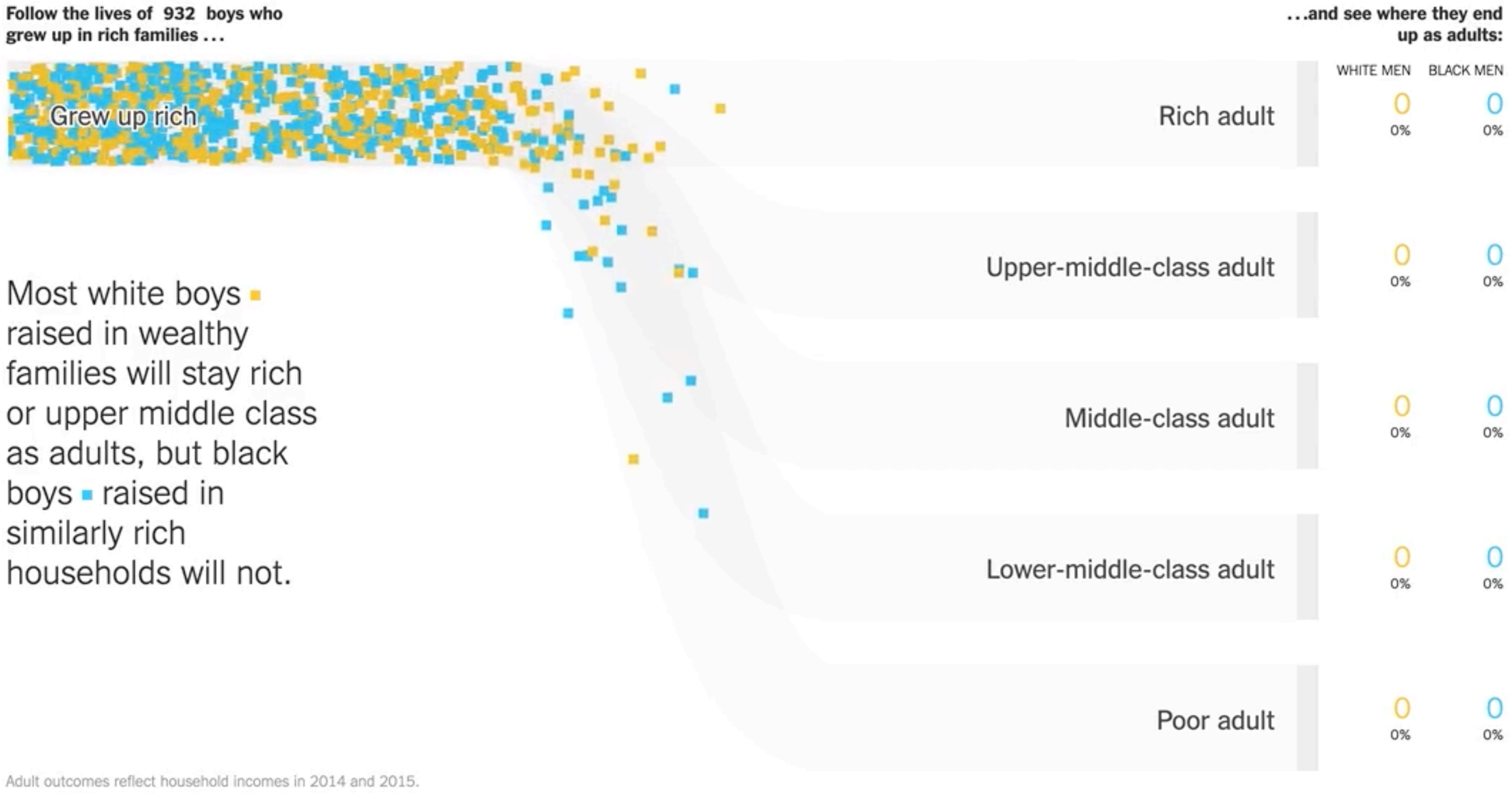
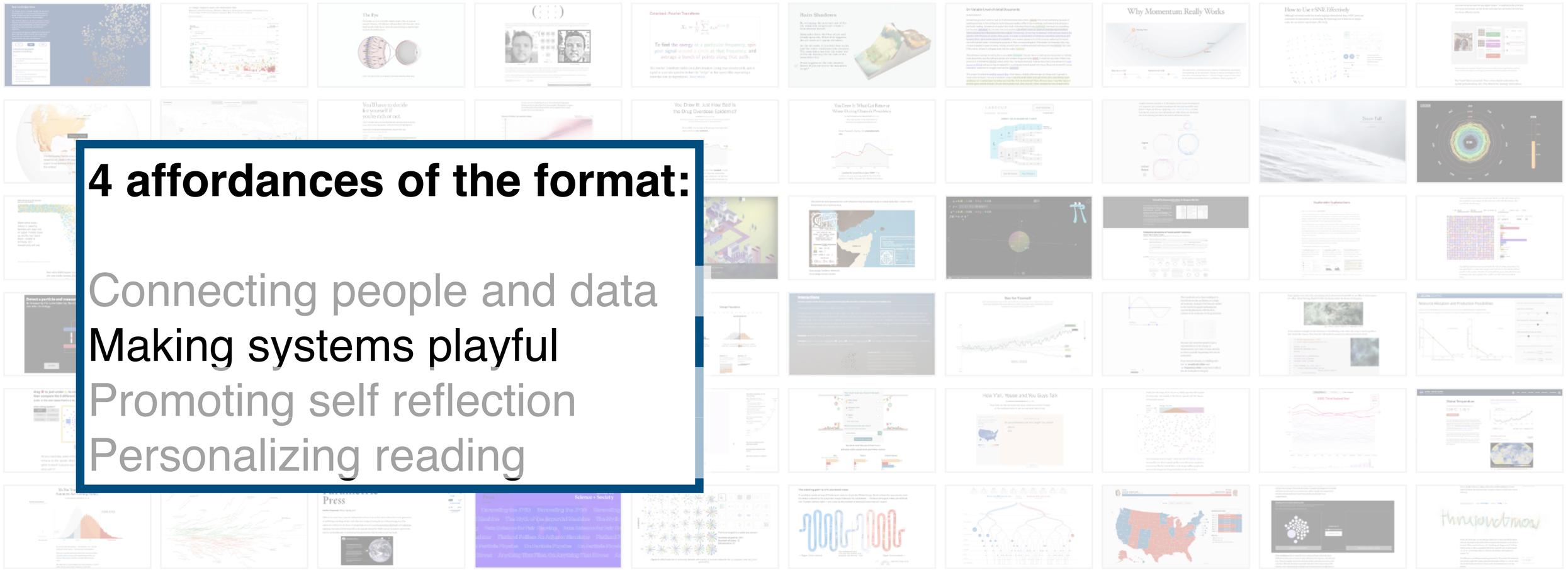


Even when children grow up next to each other with parents who earn similar incomes, black boys fare worse than white

https://www.nytimes.com/interactive/2018/03/19/upshot/race-class-white-and-black-men.html

Practice: I like, I wish, What if?

fivethirtyeight.com/features/gun-deaths



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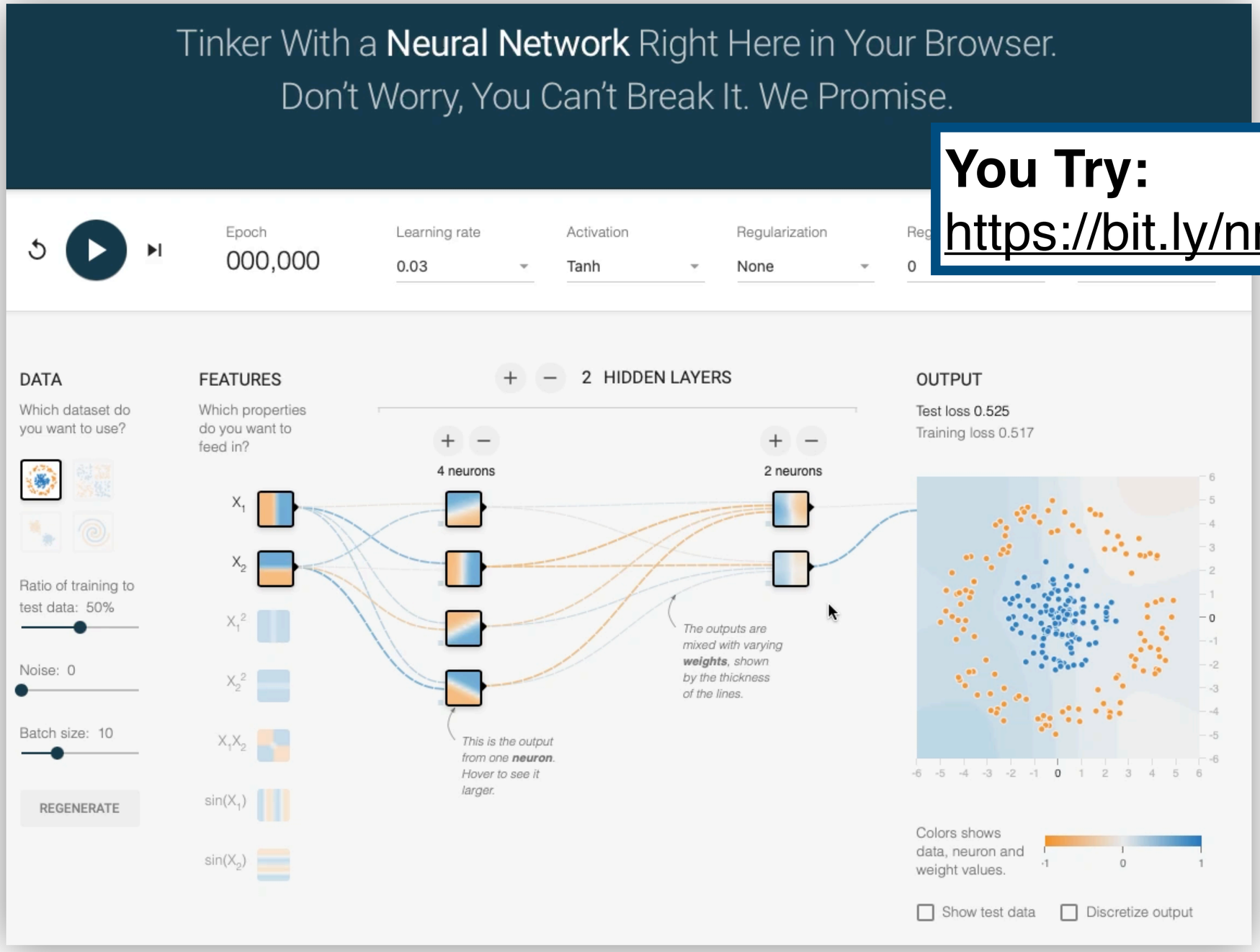
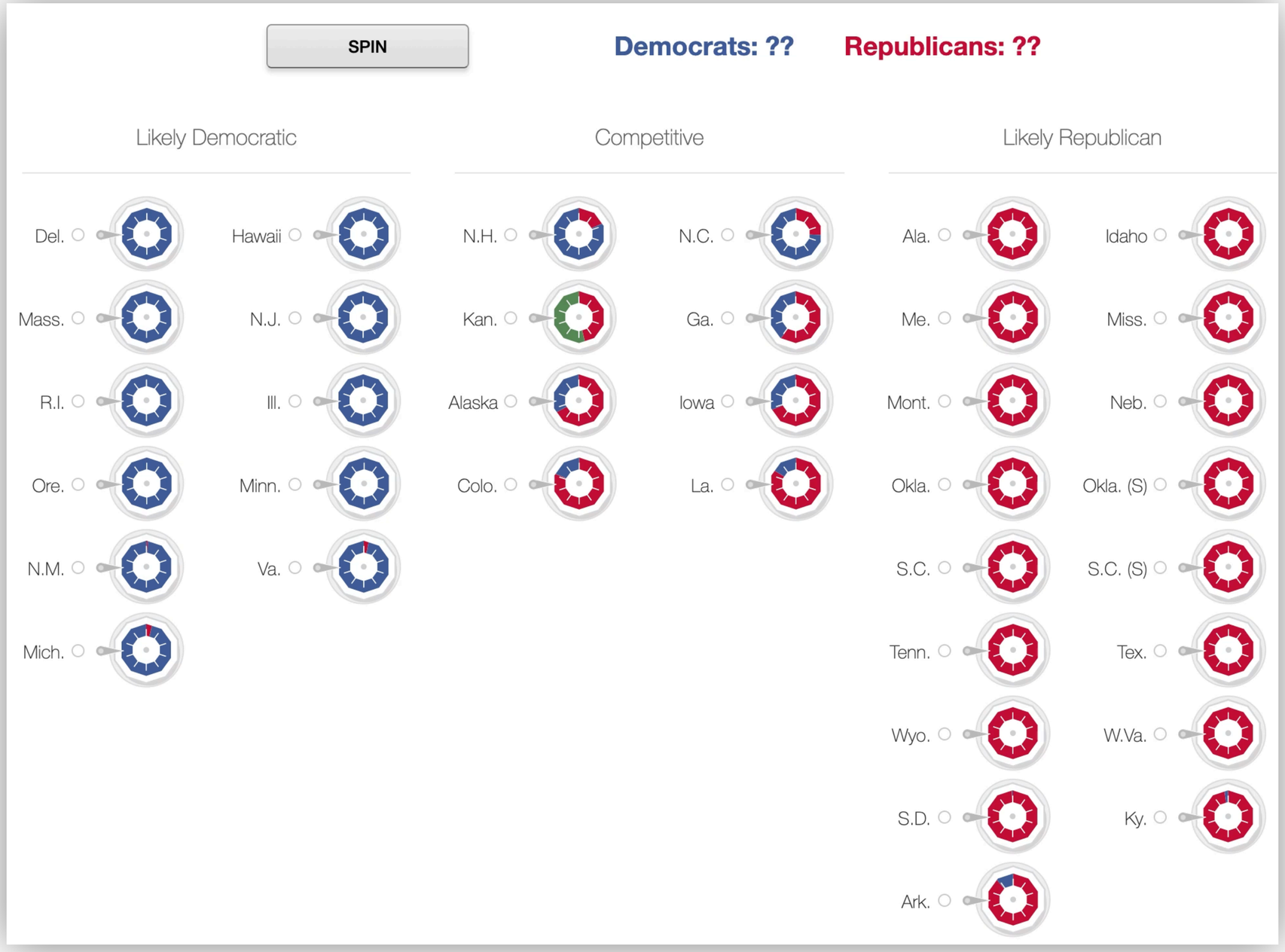
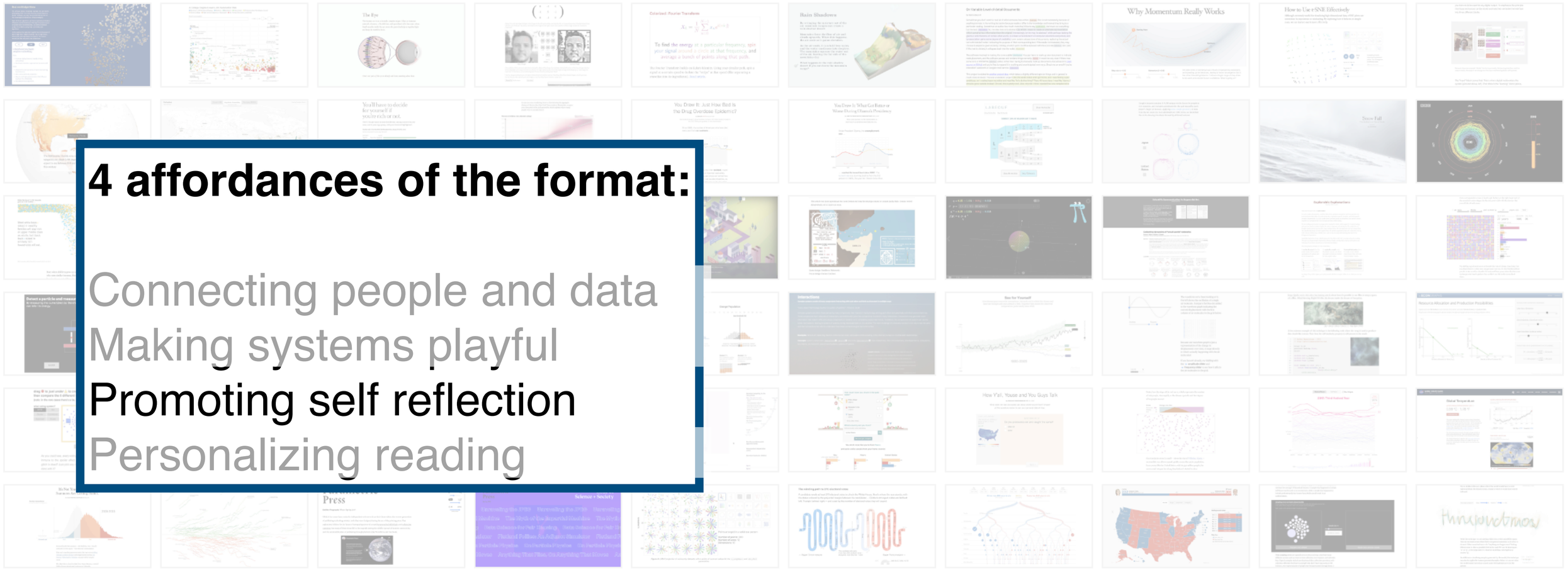


You Try:
https://bit.ly/nn-play

https://playground.tensorflow.org/



https://www.nytimes.com/newsgraphics/2014/senate-model/index.html



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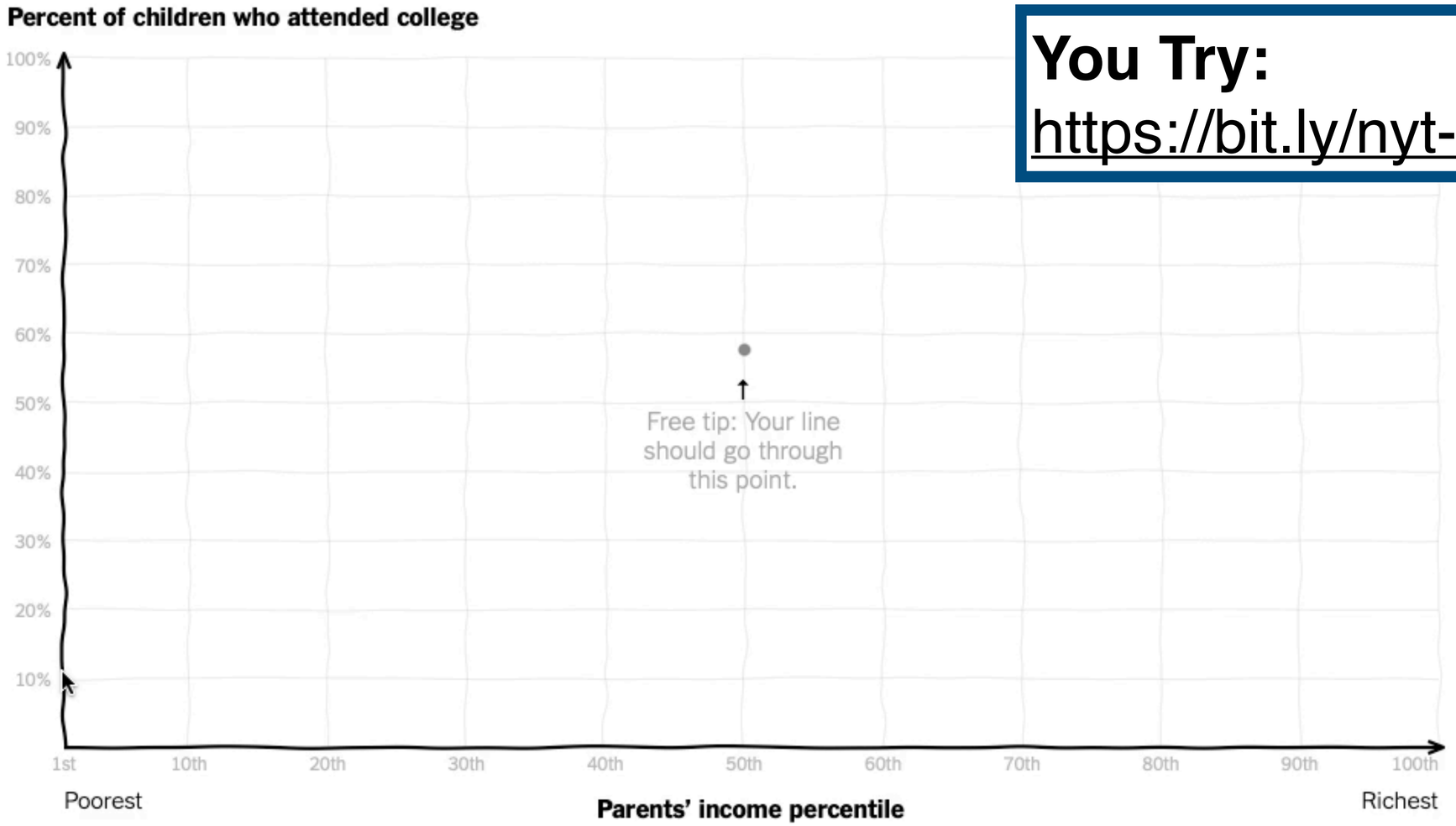
Draw your line on the chart below

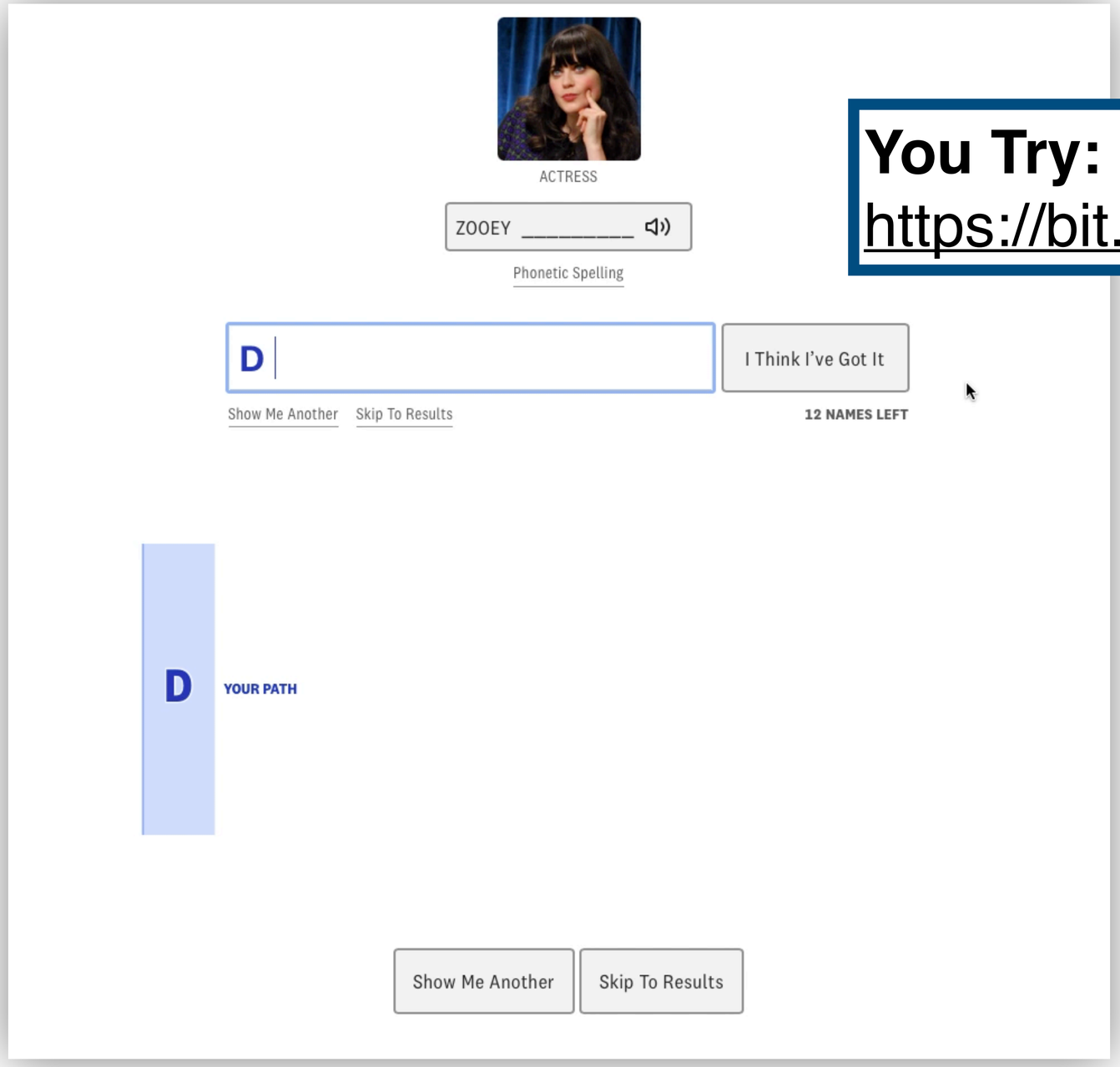


I'm done

Start over

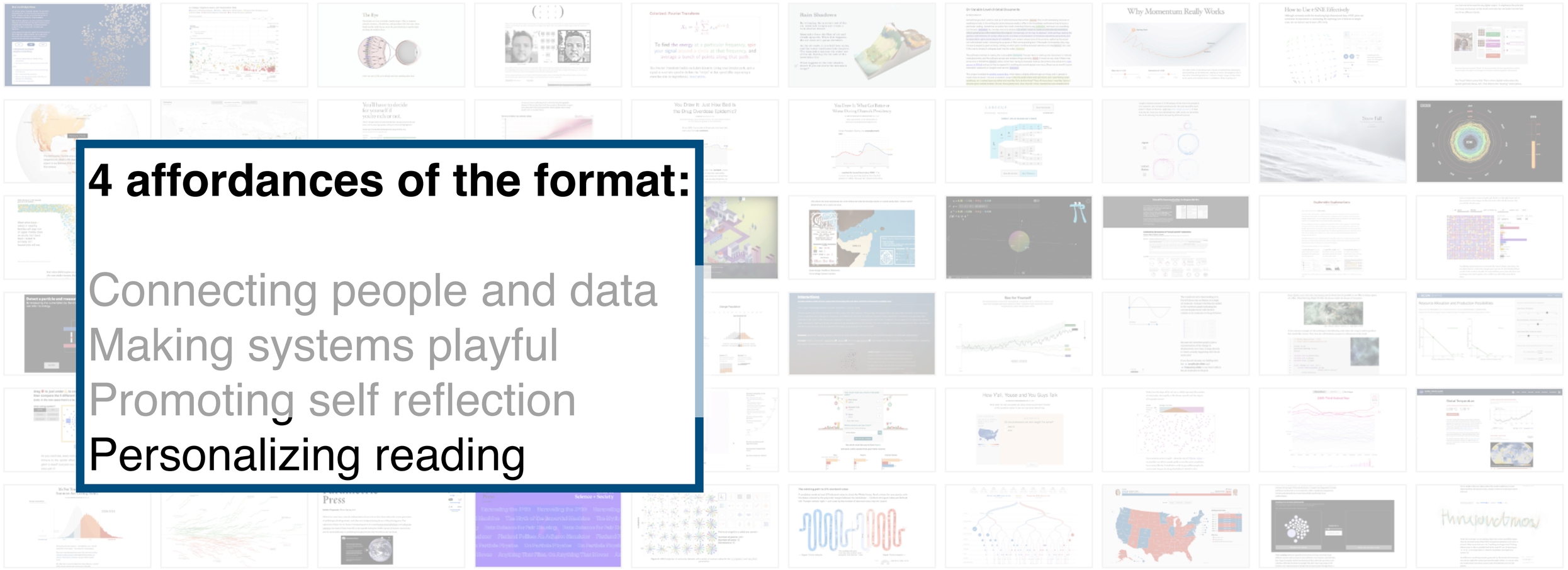
You Try:
https://bit.ly/nyt-college

https://www.nytimes.com/interactive/2015/05/28/upshot/you-draw-it-how-family-income-affects-childrens-college-chances.html



You Try:
https://bit.ly/pudding-gy

https://pudding.cool/2019/02/gyllenhaal/



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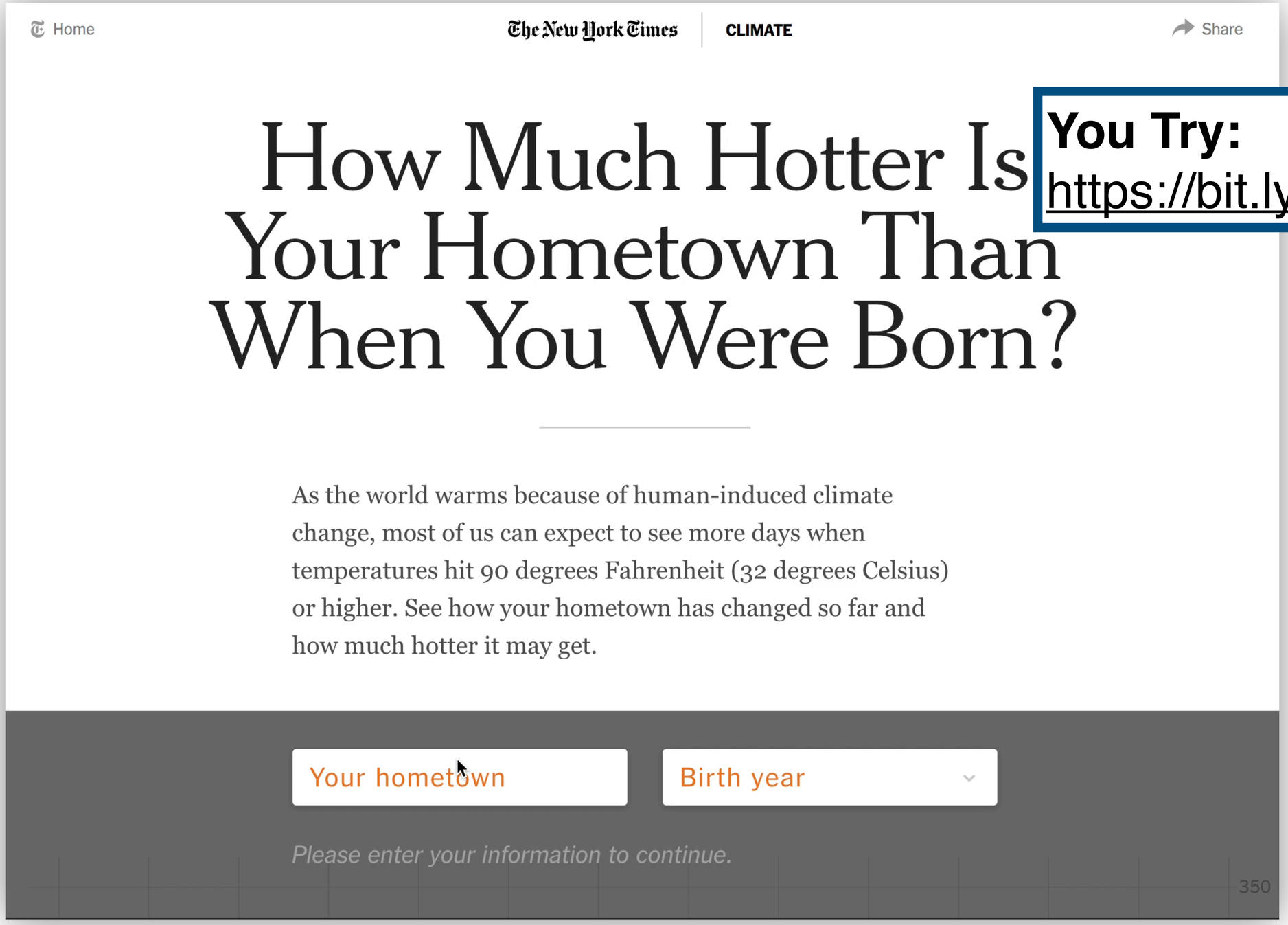


You Try:
https://bit.ly/nyt-hot

https://www.nytimes.com/interactive/2018/08/30/climate/how-much-hotter-is-your-hometown.html

ATLAS OF ME

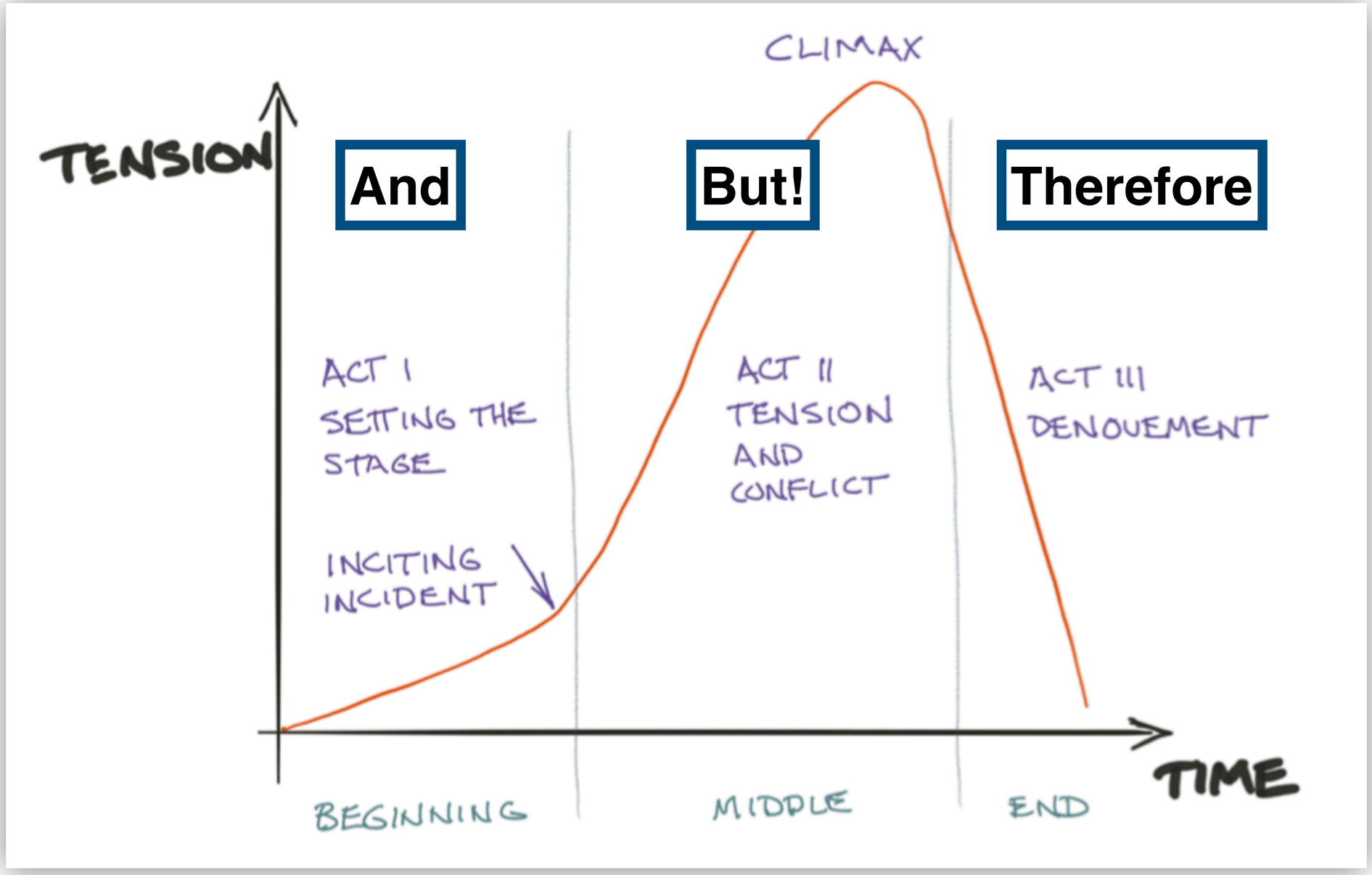
On-demand personalized maps for unfamiliar distances, areas, and locations.

Created by **Yea-Seul Kim**, **Francis Nguyen**, and **Jessica Hullman**, University of Washington

Narrative Visualization

Aka: Telling a story using data

You'll make one for your final project!

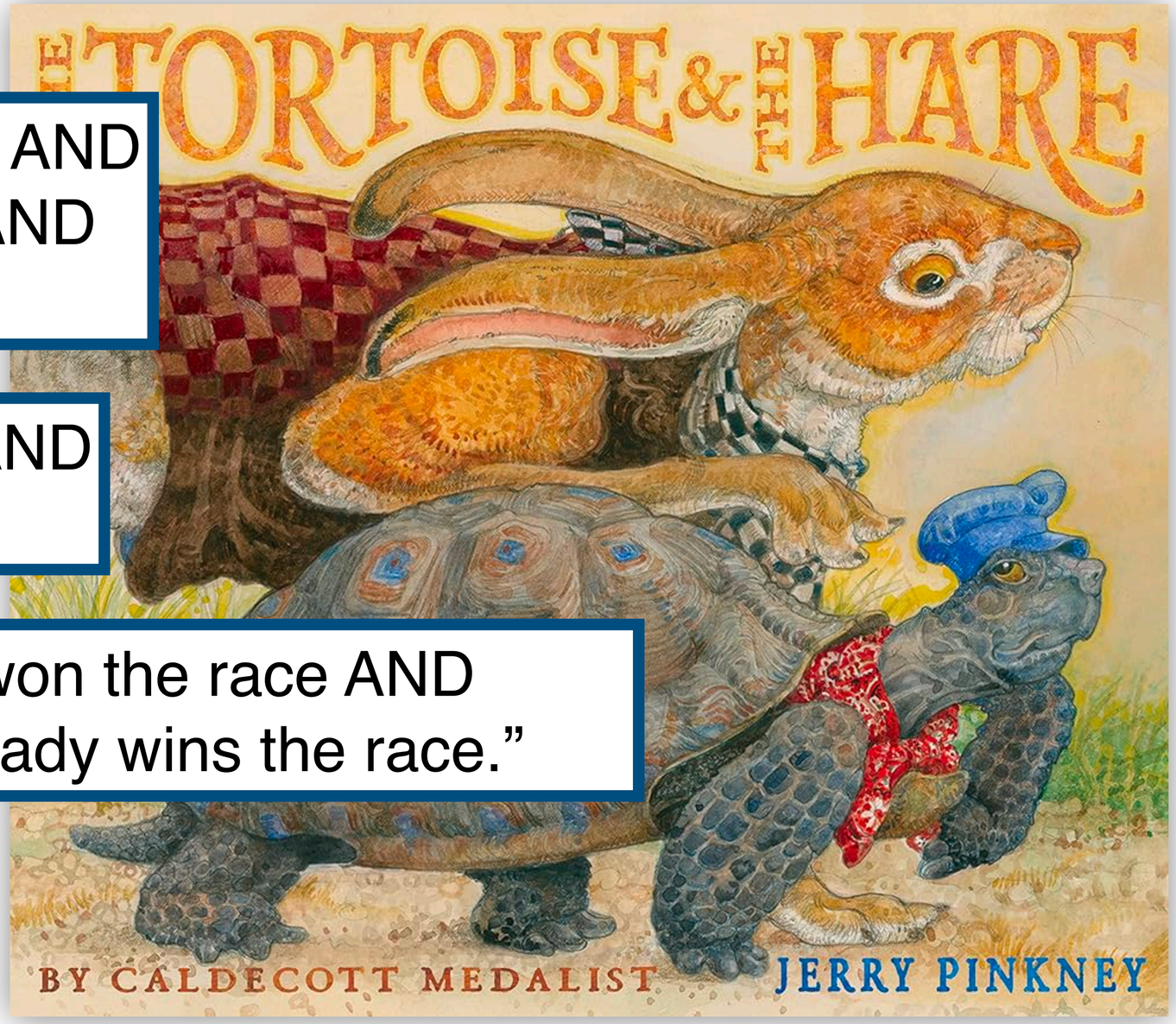


https://www.formalifesciencemarketing.com/white-papers/life-science-stories-and-but-therefore/

There was a boastful rabbit AND
There was a slow tortoise AND
They decided to race…

BUT the rabbit fell asleep AND
The tortoise plodded on…

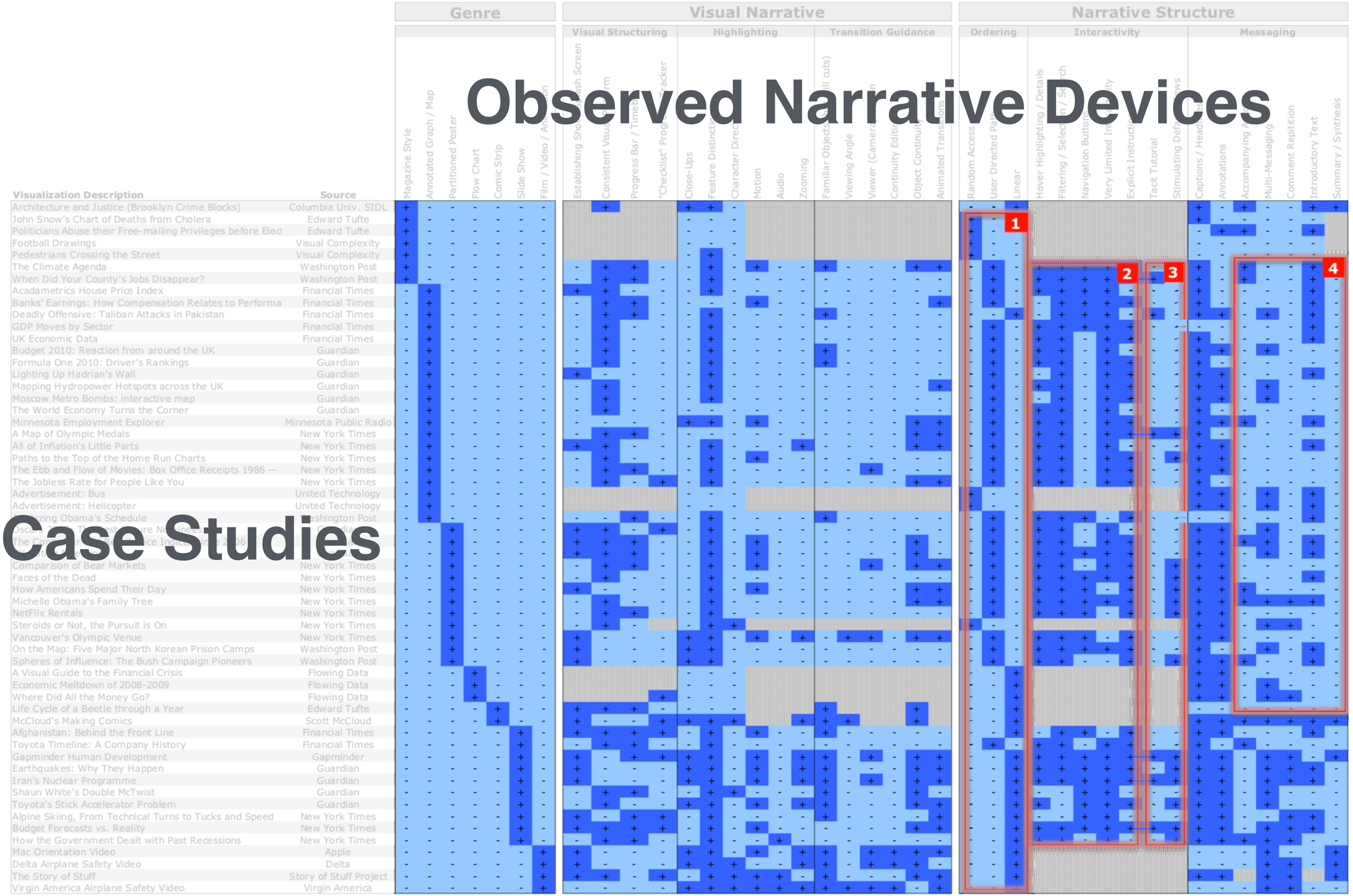
THEREFORE the tortoise won the race AND
The moral is: “Slow and steady wins the race.”



How does this visualization use and-but-therefore?

fivethirtyeight.com/features/gun-deaths

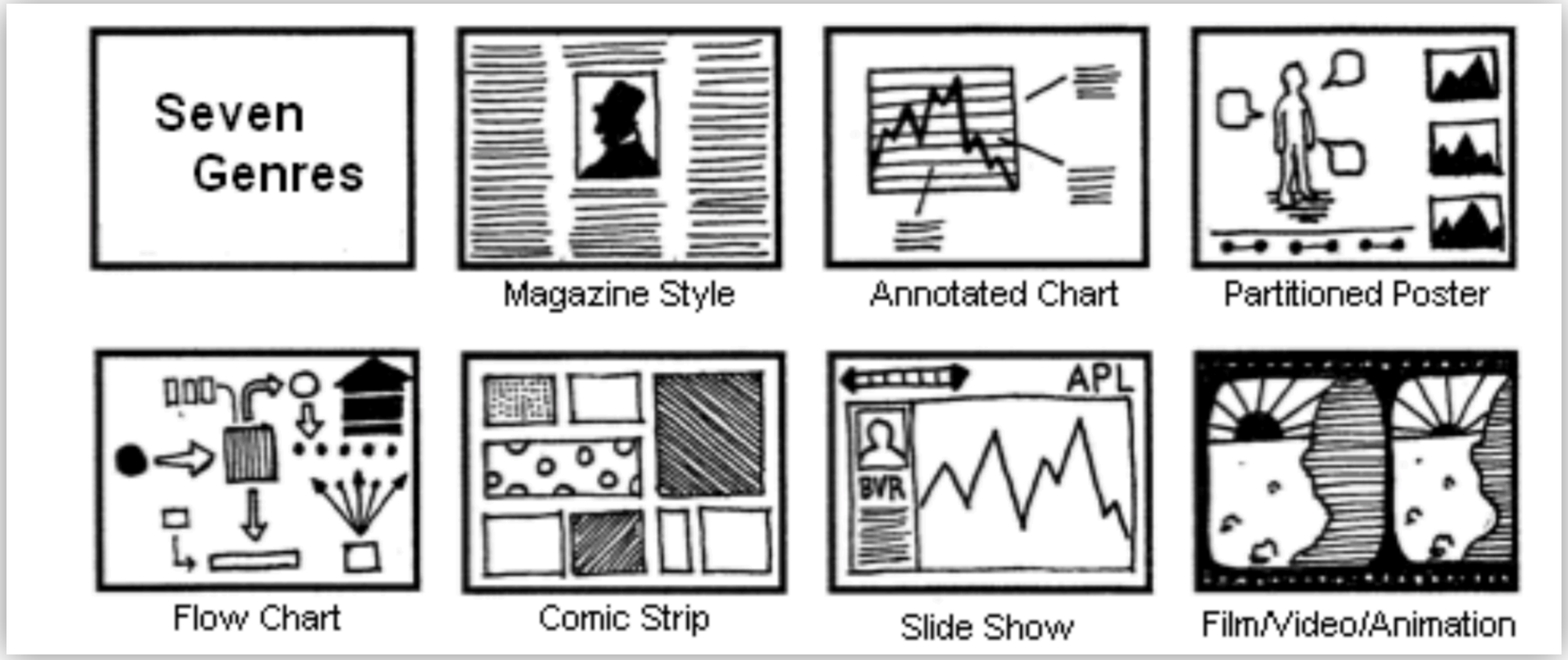
Observed Narrative Devices



Case Studies

Segel, Edward, and Jeffrey Heer. "Narrative visualization: Telling stories with data." 2010

Narrative Visualization Genres



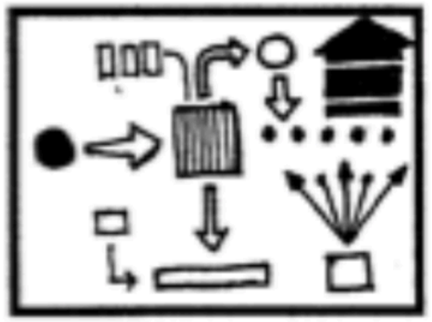
Magazine Style

even more sharply in Germany than in Italy, which is in recession, note economists at Goldman Sachs, a bank. Yet Germany's service sector appears to be growing strongly, as does that of the euro zone as a whole.

The Economist

Service industries are less volatile than manufacturing, make up a bigger slice of rich-world GDP and, by their nature, trade less. That they remain strong largely reflects relatively buoyant labour markets and consumers (German unemployment is only 3.1%). One exception has been Britain, where survey data released on April 1st and 3rd appear to show growth in manufacturing at its strongest in over a year and services shrinking. Both findings are Brexit-related. The British economy is suffering from falling confidence, while manufacturing appears so strong only because firms are stockpiling in case Britain soon crashes out of the EU without a deal.

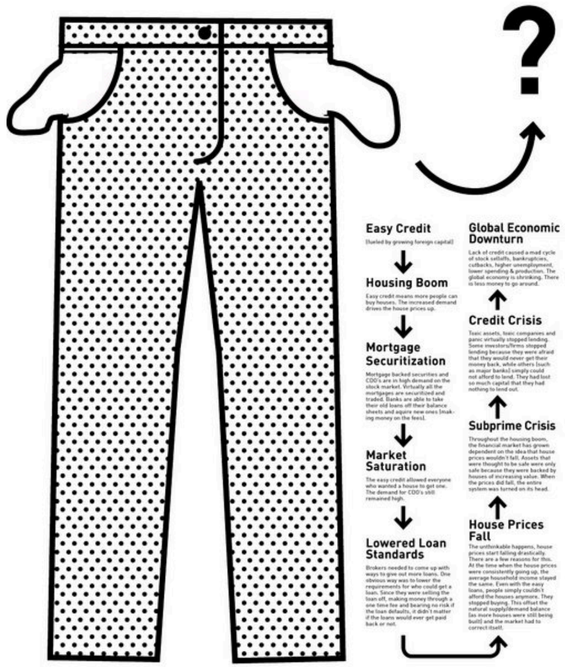
In the 2000s some economists speculated that the growing weight of



Flow Chart

WHERE

DID ALL THE MONEY GO?

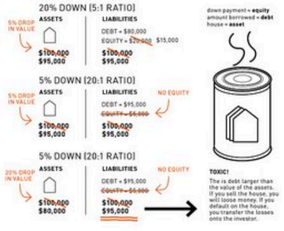


Easy Credit

No cash? No problem! As the global economy grew, the amount of money available for investment grew exponentially. Since a loan is a high yielding investment, there was a huge incentive to give out as many loans as possible, generating a society dependent on credit. Companies and individuals alike rely on credit to purchase even their most basic needs. Currently, US household debt adds up to a 100% of our GDP. That means that private Americans alone hold as much debt as the entire country produces in a year. This has happened only once before - in 1929.

Debt Turns Toxic

When you take out a loan on a house, you are employing one of the most basic tools of finance - leverage. You are taking on debt to supplement your savings (your equity) in order to buy an asset - the house. The higher the leverage (lower down payment), the riskier the investment. Watch what happens when the house prices fall.



Crisis Spreads

The short term lending that most companies rely on for day to day business practically stopped. This had enormous implications to the economy. It meant that most businesses were short on cash. The capital they usually borrow to pay for daily operations and payroll was simply not there. They had no choice but to cut costs. Jobs were cut, projects cancelled and company spending frozen. The lack of credit also uncovered deep financial problems that companies and individuals were able to hide by taking on more debt. Just like people borrowed more money in order to make their mortgage payments, companies borrowed to cover their losses.

Easy Credit

(fueled by growing foreign capital)

Housing Boom

Easy credit means more people can buy houses. The increased demand drives the house prices up.

Mortgage Securitization

Mortgage backed securities and CDO's are in high demand on the stock market. Virtually all the mortgages are securitized and traded. Banks are able to take their old loans off their balance sheets and aquire new ones (making money on the fees).

Market Saturation

The easy credit allowed everyone who wanted a house to get one. The demand for CDO's still remained high.

Lowered Loan Standards

Brokers needed to come up with ways to give out more loans. One way was to relax the requirements for who could get a loan. Since they were selling the loan off, making money through a one time fee and bearing no risk if the loan defaults, it didn't matter if the loans would ever get paid back or not.

Global Economic Downturn

Lack of credit caused a mad cycle of stock selloffs, bankruptcies, cutbacks, higher unemployment, more selloffs, and so forth. The global economy is shrinking. There is less money to go around.

Credit Crisis

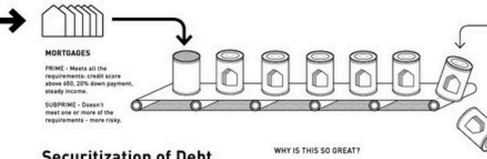
Toxic assets, toxic companies and panic virtually stopped lending. Some investors/firms stopped lending because they were afraid that they would never get their money back, while others (such as major banks) simply could not afford to lend. They had lost so much money that they had nothing to lend out.

Subprime Crisis

Throughout the housing boom, the financial market has grown dependent on the idea that house prices wouldn't fall. Assets that were thought to be safe were only safe because they were backed by houses of increasing value. When the prices did fall, the entire system was turned on its head.

House Prices Fall

The unthinkable happens, house prices start falling drastically. There are a few reasons for this. First, as the housing prices were consistently going up, the average household income stayed the same. Even with the easy loans, people simply couldn't afford the houses anymore. They stopped buying. This offset the natural supply/demand balance (as more houses were still being built) and the market had to correct itself.

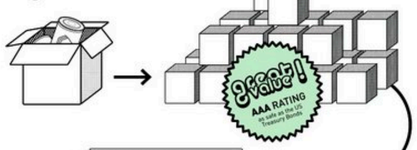


Securitization of Debt

Thousands of debts, such as mortgages, credit card debts or college loans, get packaged into a convenient storage unit called a security. Unlike individual loans, these securities can be sold and traded on the stock market. They eliminate the hassle of managing loans while still giving high profit returns.

WHY IS THIS SO GREAT?

As long as the house prices don't fall, there is really no way to loose money. If the people stop paying and default on their mortgage, you get their house - which if the house prices keep going up, is probably worth more then the mortgage itself. And because the CDOs are so diversified and so large, the risk is spread out.



As the debtors paid their monthly payments, the loan securities generated a return. Since there is always a small % of people who won't make their payments, the security is divided into different levels of risk. The safest investors get paid first and the riskiest last. In return, the riskiest investments get a bigger share of the profit. When the housing market was booming, everyone got paid. As the house prices started falling, however, the securities stopped giving returns. They became toxic.

Investors

The global economy has been growing fast. It has been acquiring enormous amounts of capital. This money had to be invested somewhere. The CDOs were particularly appealing because they were perceived as safe and they yielded a high interest rate at a time when the U.S. Bonds were at a record low.

Demand Lowers Standards

As the demand for Mortgage Securities grew, the supply dryed up. Everyone who qualified for a loan and wanted one, already had one. In order to generate more loans to satisfy the growing demand for securities, the standards for getting a loan were lowered. Not only did this create "toxic" loans (packaged into toxic securities), but it also triggered the burst of the housing bubble. As the house prices peaked, the average income stayed flat. People couldn't afford to buy the overpriced houses. The housing market stopped, the prices fell & everyone found themselves owing a lot more then they owned.

Credit Crisis

The toxic assets made their way through the financial system quickly. After several investment firms "broke the buck" - loosing the investors money, and several major companies nearly collapsed, full blown panic set in. No one knew who was going to go under next. Because the assets they were holding were so complex, unregulated, and interconnected no one even knew to what extent their own assets were exposed. Lending stopped.

What is money?

Money can be anything. Rare & valuable resources have been used historically because they are easy to control, but anything that people collectively agree on can be used as money. There are four general functions money fulfills: medium of exchange, unit of account, store of value & standard of deferred payment. Money needs to have a perceived value. This is an overview of the different forms of money and where their value comes from.

Barter

In a barter, no money is used. People trade goods or services directly.

no money

Commodity Money

The value comes from the commodity it is made out of (gold, silver, bronze). In other words, a $1 coin made out of silver would have $1's worth of silver in it.

money = commodity

Representative Money

Token money that stands in direct and fixed relation to the commodity which backs it, while not itself made of it. (eg. early paper money which originated as receipt for gold deposits).

money = tokens backed by a commodity

Credit Money

When you take out a loan, you agree to pay it back. In return the bank transfers money to your account. This money is not directly backed by a commodity. It is created when you take out the loan and is backed by your promise to pay it back.

money = promise to repay

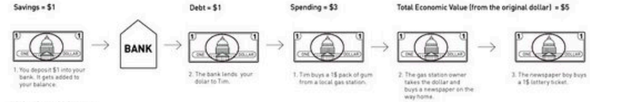
Fiat Money

Money which is not backed by a commodity, but by a government law declaring it to be legal tender (currency that must be accepted as payment). It is usually printed by the country's national bank (a private institution).

money = paper given value by law

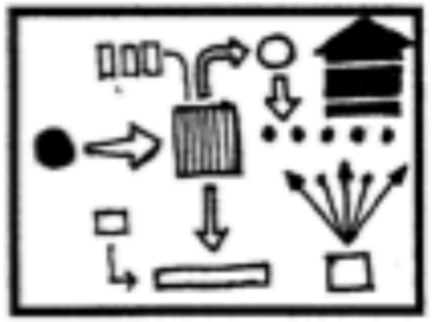
Money Supply

The Money Supply is the amount of available money in the economy. It fluctuates with the market. In times of economic growth, the money supply is high. In a recession, the money supply is low. Lending and spending are two major factors that influence the money supply.



Velocity of Money

As a $1 bill circulates throughout the day, it multiplies its value in the economy. Every time it changes hands, it creates another $1 in economic activity. In a recession, when lending & spending is lower, there is actually less money in the economy. While no cash disappears, the velocity of the dollar goes down.



Flow Chart

Partitioned Poster

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

755
714
23 seasons
22 seasons
20 seasons

Bonds was injured last season. He played 14 games and hit 5 homers.

600
400
200
0
14th season
5 seasons
10
15

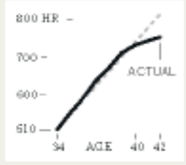
According to allegations in a book about Bonds, he began taking steroids before the 1999 season, his 14th in the league. Two seasons later, he hit 73 home runs, surpassing Aaron's career pace.

Homer Pace After Age 34

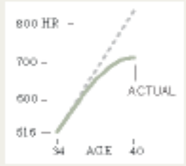
If the accusations are correct, Bonds was 34 in his first season on steroids. Here are projected home run paces for each player after age 34.

PROJECTED PACE BASED ON AVERAGE OF PREVIOUS FIVE SEASONS

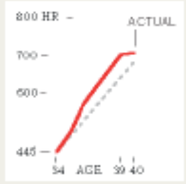
Aaron
Actual homers slightly outpace projected homers for five seasons.



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

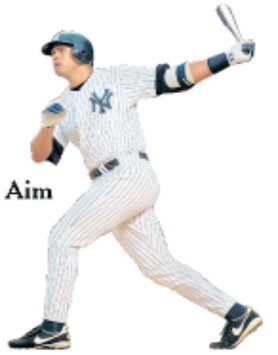


Bonds
From age 35 to 39, he averaged 14 more homers a season than projected.

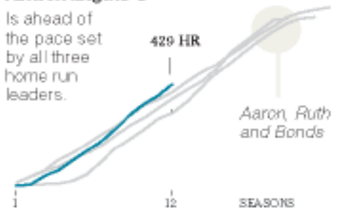


Note: Ages as of July 1 of each season.

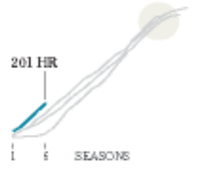
Others Taking Aim



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



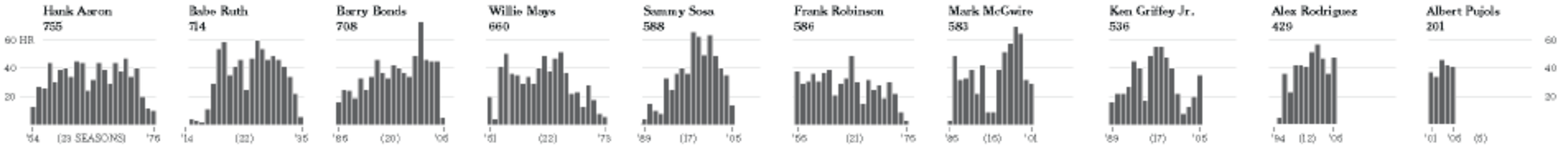
Albert Pujols
Averaging 40 homers a season, he has started stronger than the three leaders did.



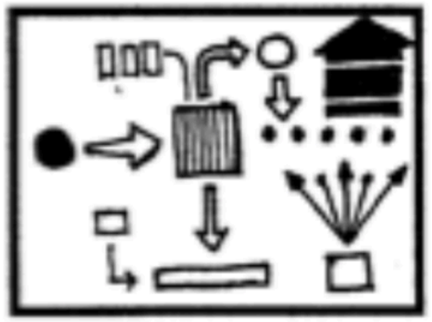
Ken Griffey Jr.
Many thought he would be the first to catch Ruth and Aaron until injuries limited his output.

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).



Amanda Cox and Joe Ward/The New York Times



Flow Chart

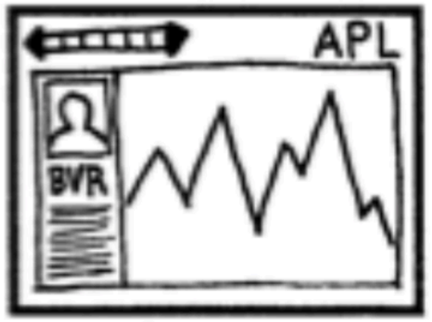
Partitioned Poster

Beginning

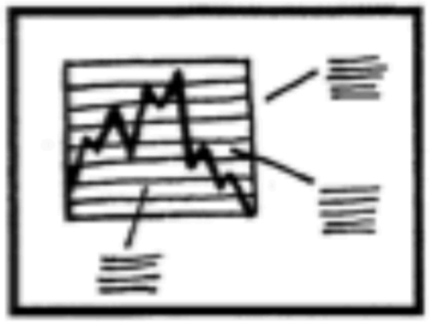
Middle

End

Epilogue



Slide Show



Annotated Chart

Published: February 2, 2010

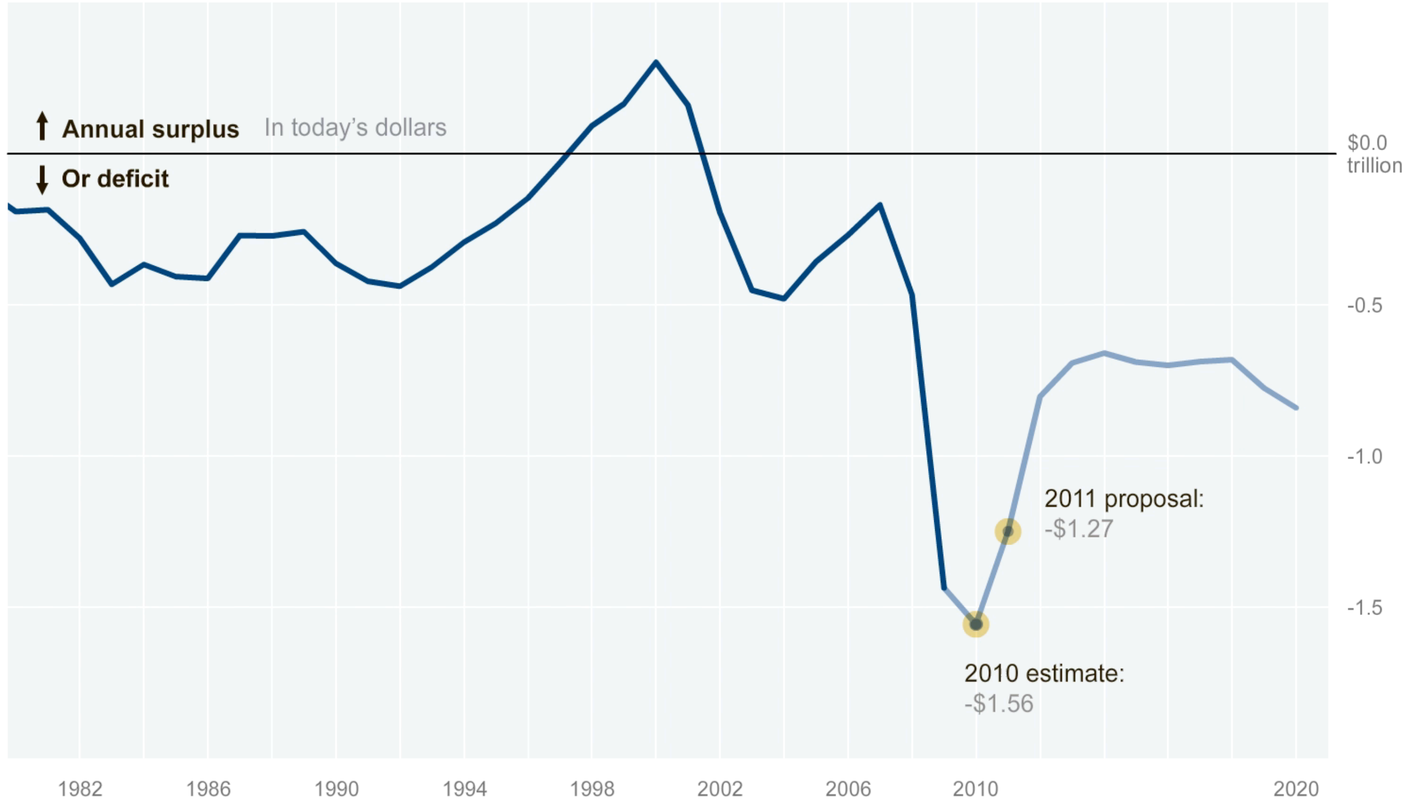
Budget Forecasts, Compared With Reality

Just two years ago, surpluses were predicted by 2012. How accurate have past White House budget forecasts been?

1 2 3 4 5 6 NEXT

Falling short

President Obama's budget proposal estimates a deficit of $1.6 trillion for the current fiscal year and $1.3 trillion in 2011.



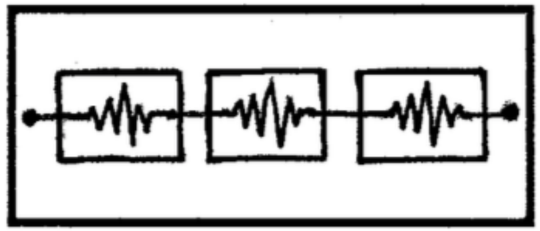
By AMANDA COX | Send Feedback

Source: Office of Management and Budget

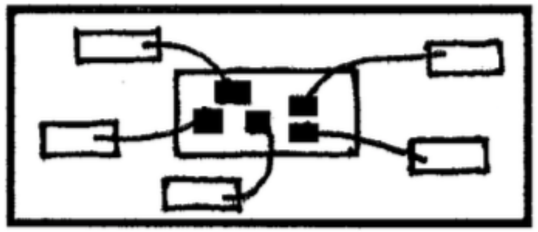
TWITTER LINKEDIN SHARE

https://archive.nytimes.com/www.nytimes.com/interactive/2010/02/02/us/politics/20100201-budget-porcupine-graphic.html

Interactive Slideshow

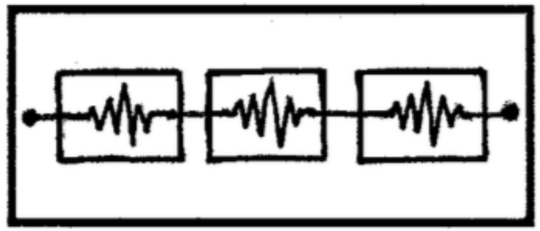


Drill-Down

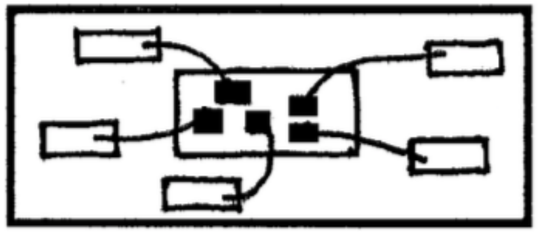


Author-Driven ⟷ **Reader-Driven**

Interactive Slideshow



Drill-Down



Author-Driven ⟷ **Reader-Driven**

On the Map: Five Major North Korean Prison Camps

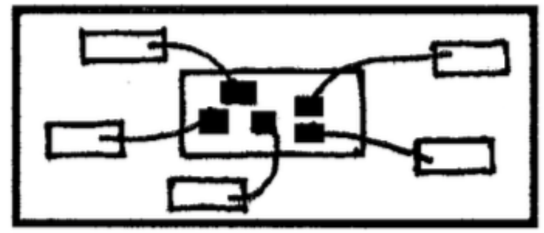
North Korea has operated political prison camps for more than 50 years, twice as long as the Gulag in the former Soviet Union. People suspected of opposing the government are forced to do slave labor in the camps, which hold an estimated 200,000 prisoners. North Korea's government says the camps don't exist, but high-resolution satellite images show otherwise.

Click on the i map markers below for more information on each site.

RELATED
- Article: On the Diplomatic Back Burner
- Google Earth: North Korea Uncovered

SOURCES: North Korea Uncovered; Korean Bar Association ("2008 White Paper on Human Rights in North Korea"); "The Hidden Gulag," David Hawk, U.S. Committee for Human Rights in North Korea; Joshua Stanton, One Free Korea; interviews with former prisoners and guards; Satellite Images: Google Earth; GRAPHIC: Kat Downs, Blaine Harden, Liz Heron, Laris Karklis and Francine Uenuma - The Washington Post

Drill-Down



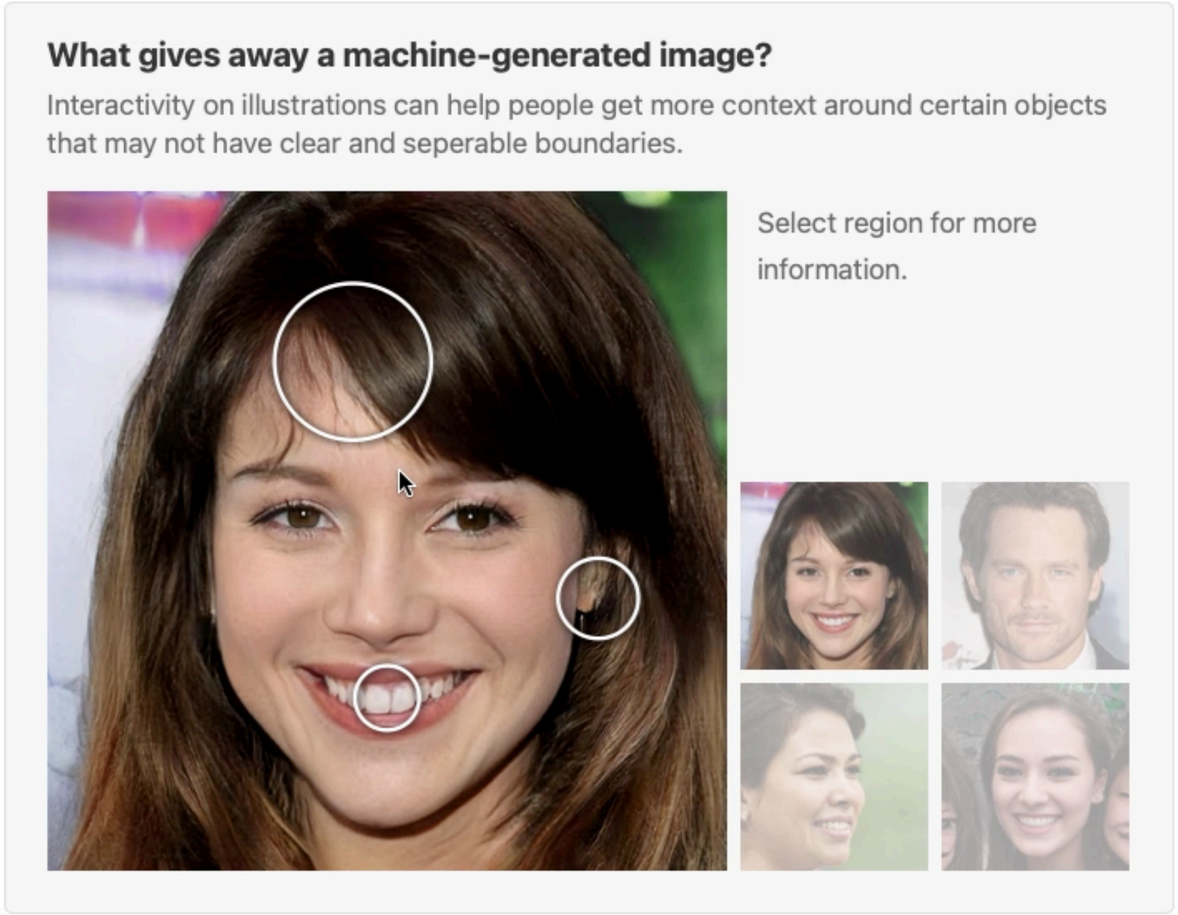


FIGURE 7: Choose between 1 of 4 machine-generated images and brush over the circle callouts to display a short message about each region. Generated images from [128, 129].

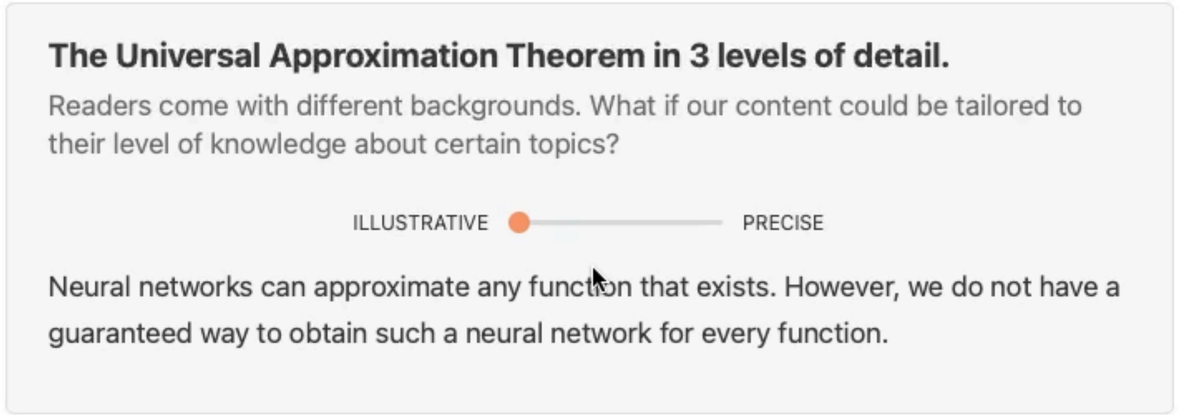
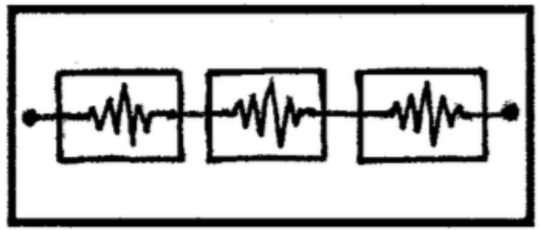


FIGURE 9: Drag the slider to display the theorem's statement in increasing levels of detail.

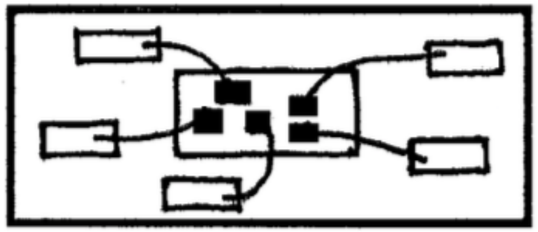
PREVIEWING CONTENT

Details-on-demand can also be used as a method for previewing content without committing to another interaction or change of view. For example, when hovering over a hyperlink on Wikipedia, a preview card is shown that can contain an image and brief description; this

Interactive Slideshow



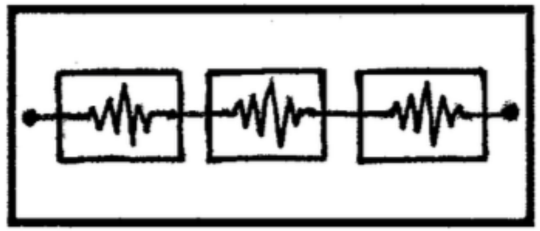
Drill-Down



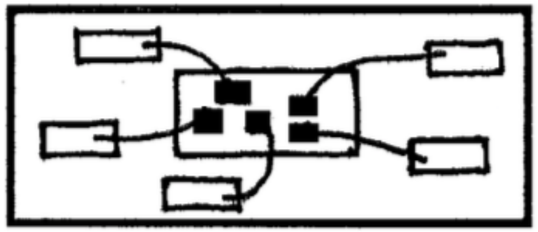
Author-Driven

Reader-Driven

Interactive Slideshow

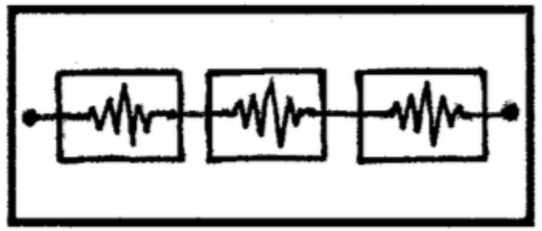


Drill-Down



Author-Driven ⟷ **Reader-Driven**

Interactive Slideshow



Copenhagen: Emissions, Treaties and Impacts

At the Copenhagen climate conference, discussions are likely to cover emissions levels, the legacy of the Kyoto Protocol and the risks of inaction on global warming. Explore each issue in the tabs below.

Global Emissions | **Lessons From Kyoto** | Possible Impact

Stepper

1 2 3 4 5 6 7 8 9 10 11 NEXT ▸

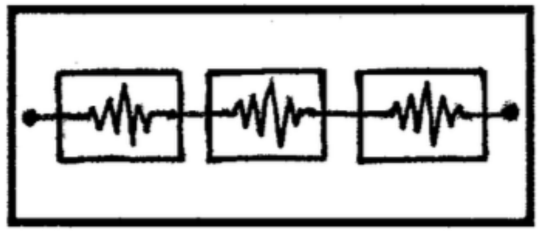
Almost every country in the world signed and ratified the protocol. The treaty's aim was to provide a starting point for reducing global carbon dioxide emissions.

Countries that ratified Kyoto

Roll over countries to learn more

By JAMES BRONZAN, AMANDA COX, XAQUÍN G.V. and KEVIN QUEALY | Send Feedback

Interactive Slideshow



R2
D3

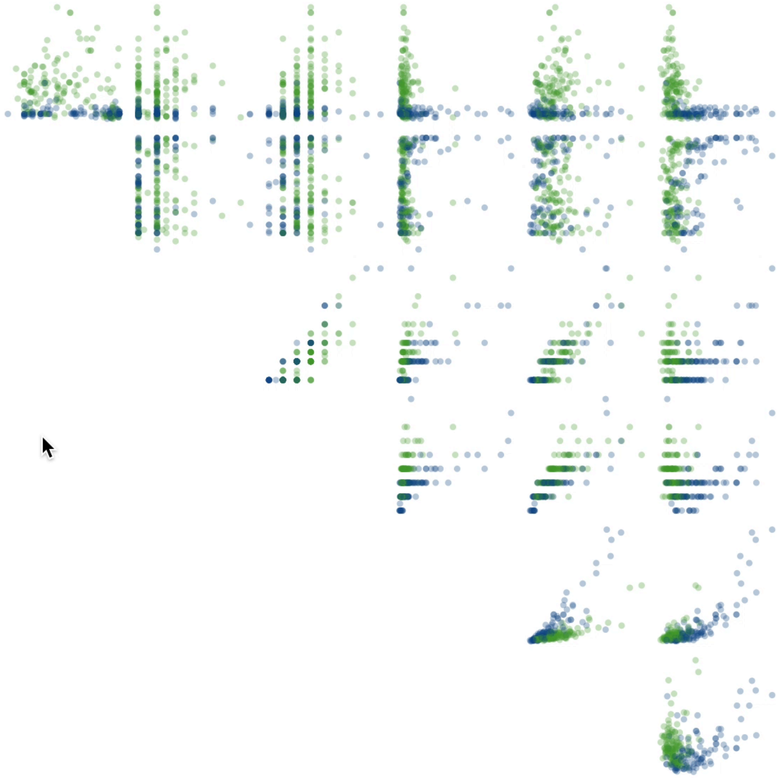
A visual introduction to machine learning

English

In machine learning, computers apply **statistical learning** techniques to automatically identify patterns in data. These techniques can be used to make highly accurate predictions.

Keep scrolling. Using a data set about homes, we will create a machine learning model to distinguish homes in New York from homes in San Francisco.

SCROLL

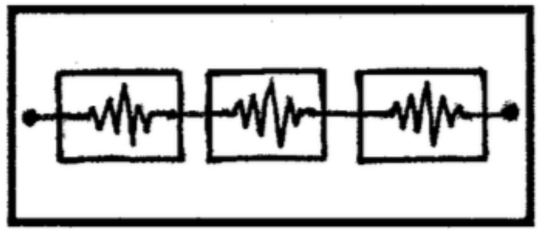


"Scrolly"-telling

http://www.r2d3.us/visual-intro-to-machine-learning-part-1/

Discrete vs. Continuous Steps

Interactive Slideshow



A source of debate among practitioners!

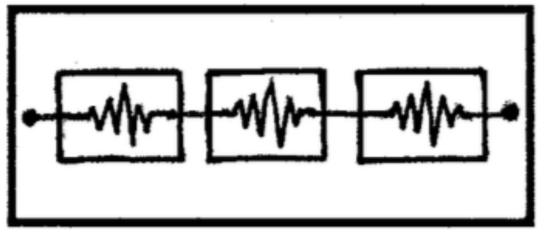
Discrete

- ✔ Simple & familiar.
- ✘ But less engaging?

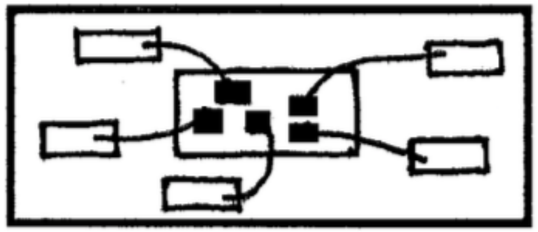
Continuous

- ✔ Less “activation energy” required.
- ✔ More fluid/direct: parameterized by scroll position = rapid, incremental experience.
- ✘ But, difficult to implement properly. Can result in *“scrolljacking.”*

Interactive Slideshow

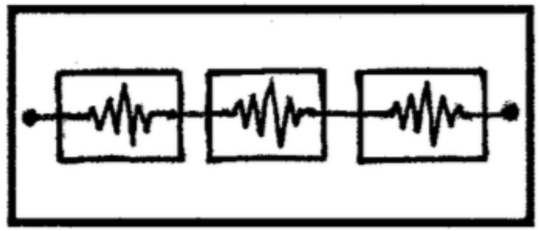


Drill-Down



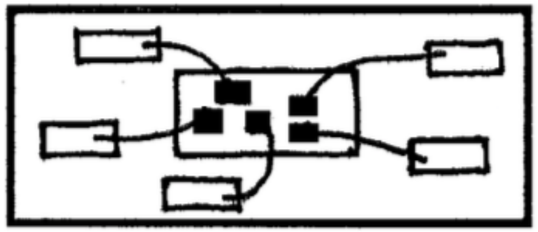
Author-Driven ⟷ **Reader-Driven**

Interactive Slideshow



Martini Glass

Drill-Down



Author-Driven ⟷ **Reader-Driven**

Kernel Density Estimation

By: Matthew Conlen

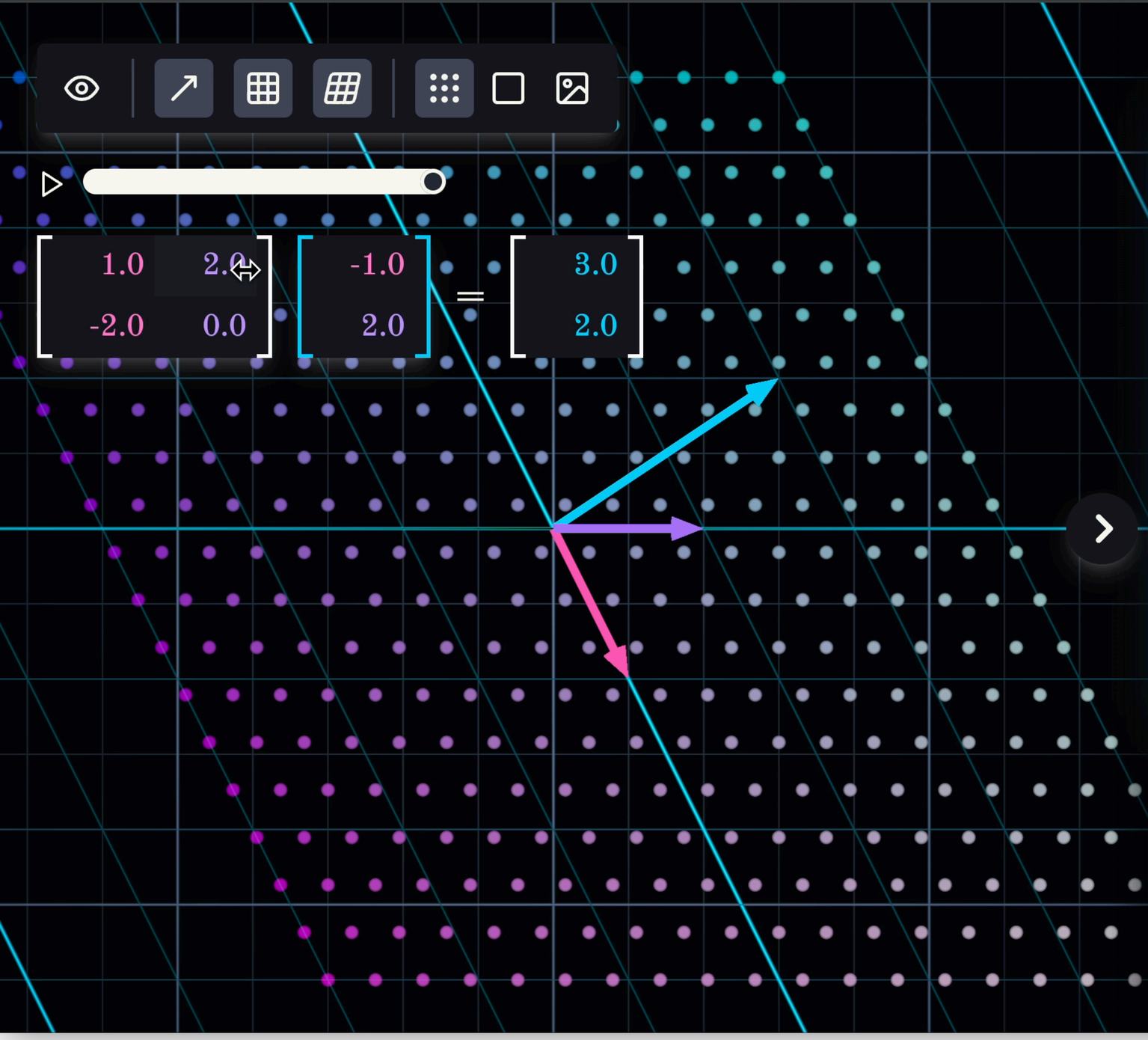
What do **matrices** mean to you?

Why do we need a way to represent an array of rows and columns of numbers, and to execute computations and operations between them?

$$\begin{bmatrix} 1 & 2 \\ -2 & 0 \end{bmatrix} \begin{bmatrix} -1 \\ 2 \end{bmatrix} = \begin{bmatrix} 3 \\ 2 \end{bmatrix}$$

In school, you may recall reluctantly performing drill after drills of matrix-vector multiplications mechanically. You may even have been taught to memorize several inane formulas.

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = x \begin{bmatrix} a \\ c \end{bmatrix} + y \begin{bmatrix} b \\ d \end{bmatrix}$$
$$= \begin{bmatrix} ax + by \\ cx + dy \end{bmatrix}$$



RECAP

- Any vector can be expressed as the addition of scaled basis vectors, i.e. **a linear combination of basis vectors**.
- A matrix can be viewed as a way to **package information about a linear transformation**. The columns of a matrix represent where the new basis vectors land after the transformation.
- Matrix-vector multiplication is a way to compute where a given vector lands after the transformation defined by a matrix.

With our understanding so far, try to tinker about and figure out what kinds of transformations are possible with matrices!

https://yizhe-ang.github.io/matrix-explorable/

Final Project:
Explorable Explanation

Final Project

Create an **Explorable Explanation**: interactive article that explains something complex to the reader.

Examples: Any example shown during today's lecture, sociological theory, scientific phenomenon, algorithm, etc.

Banned: sorting + searching algorithms. (Too common!)

Teams of 2-3. **No solo projects.**

Final Project Milestones

Proposal + Team: Mon 05/20 (this Monday)

Prototype: Mon 05/27

Demo Video: Mon 06/03

Final Project: Sat 06/08 ← No slip days allowed for final deadline

Final Project Milestones

Proposal + Team: Mon 05/20 (this Monday)

Prototype: Mon 05/27

Demo Video: Mon 06/03

Final Project: Sat 06/08 ← No slip days allowed for final deadline

Squarely Meet Requirements: 11/15 Points

Final Project Milestones

The job market is tough!

Treat this as a serious piece of your resume/portfolio to separate yourself from other applicants.