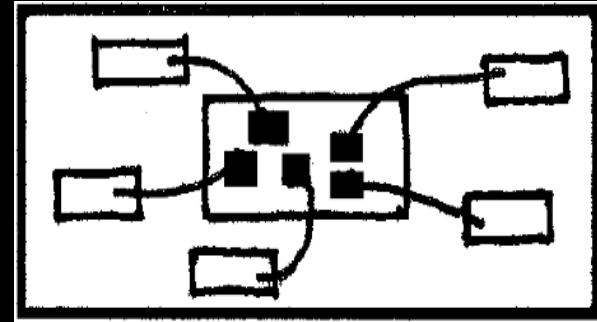
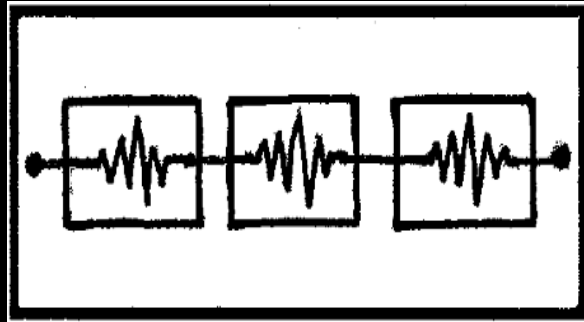
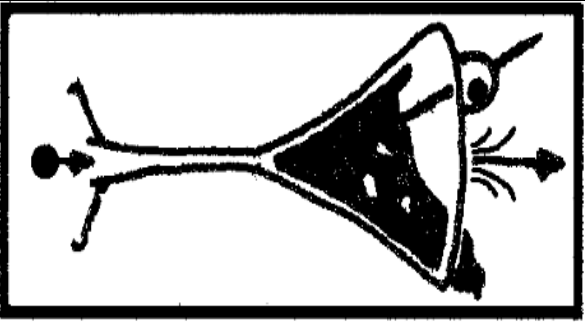


**CSE 512** - Data Visualization

# Narrative Visualization



**Jeffrey Heer** University of Washington

(with material from Edward Segel & Jessica Hullman)

# STORYTELLING

as ancient as mankind



# STORYTELLING

across various media

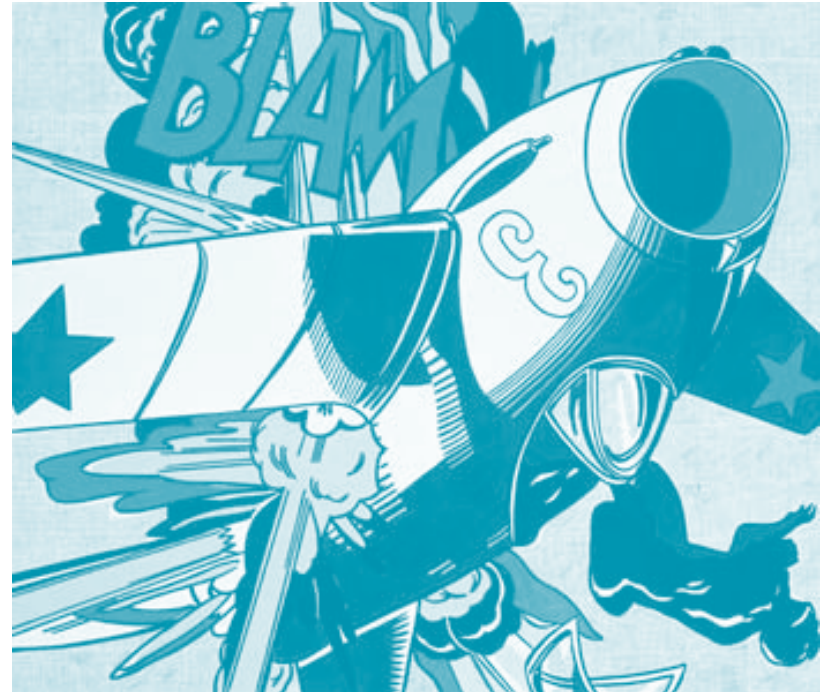
PEOPLE TELL STORIES

WORDS TELL STORIES

IMAGES TELL STORIES

COMICS TELL STORIES

MOVIES TELL STORIES



# Narrative Story-Telling

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

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

August 26, 2010

# Generals Wary of Move to Cut Their Ranks

By [GINGER THOMPSON](#) and [THOM SHANKER](#)

WASHINGTON — Maj. Gen. Paul D. Eaton, a retired Army officer, is familiar with the perks and pitfalls of power, having commanded tens of thousands of troops at Fort Benning, Ga., managed budgets exceeding \$2 billion in Iraq, and overseen layers upon layers of staff members who helped manage both his professional duties and his personal life.

He has experienced the full range of lifestyles that come with military leadership, living at one point in an elegant antebellum mansion, and at another, with eight other officers crowded in a marble bathhouse behind one of [Saddam Hussein's](#) old palaces.

When he traveled, he was occasionally able to justify the use of military aircraft, but most times, he said, he flew coach. And today he lives on a pension worth 75 percent of his military salary, with health benefits that cover everything except dental and eye care for himself and his wife.

“We are well compensated, and we live very comfortable lives,” General Eaton said, referring to the military’s most senior leaders. “But when you look at all the things going on around a general, the nation is getting a very, very high return on its money.”

Not everyone at the Pentagon agrees. Two weeks ago, Defense Secretary [Robert M. Gates](#) announced a sweeping effort to improve efficiency that, among other things, takes aim at the military’s sacrosanct corps of generals and admirals, ordering his staff to cut at least 50 positions, and making clear that he would be happier if they cut more.

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**Anecdotal Lead**

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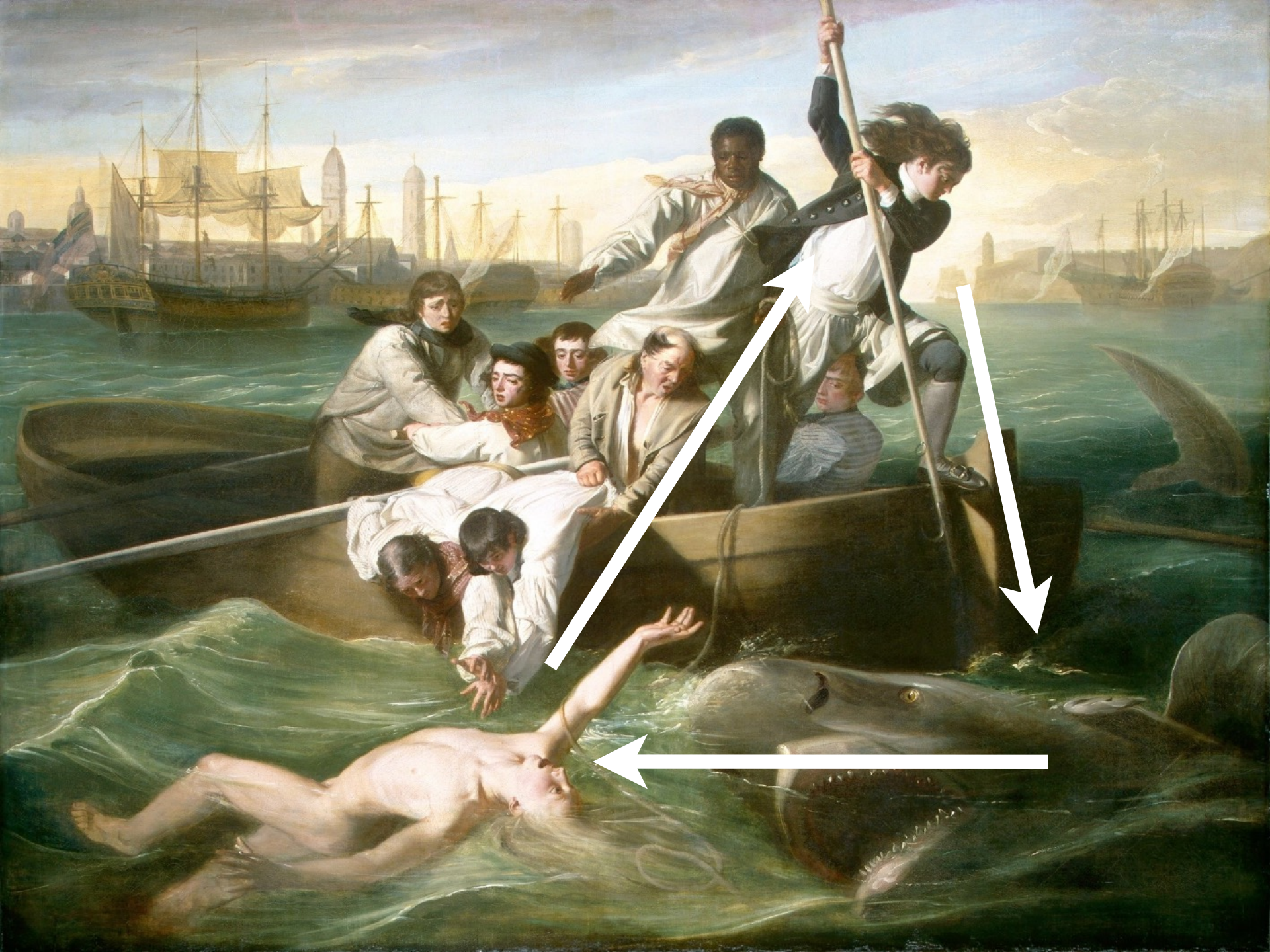
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## Nut Graph

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# Topics

Narrative visualization design

Navigation in interactive documents

Chart sequence models

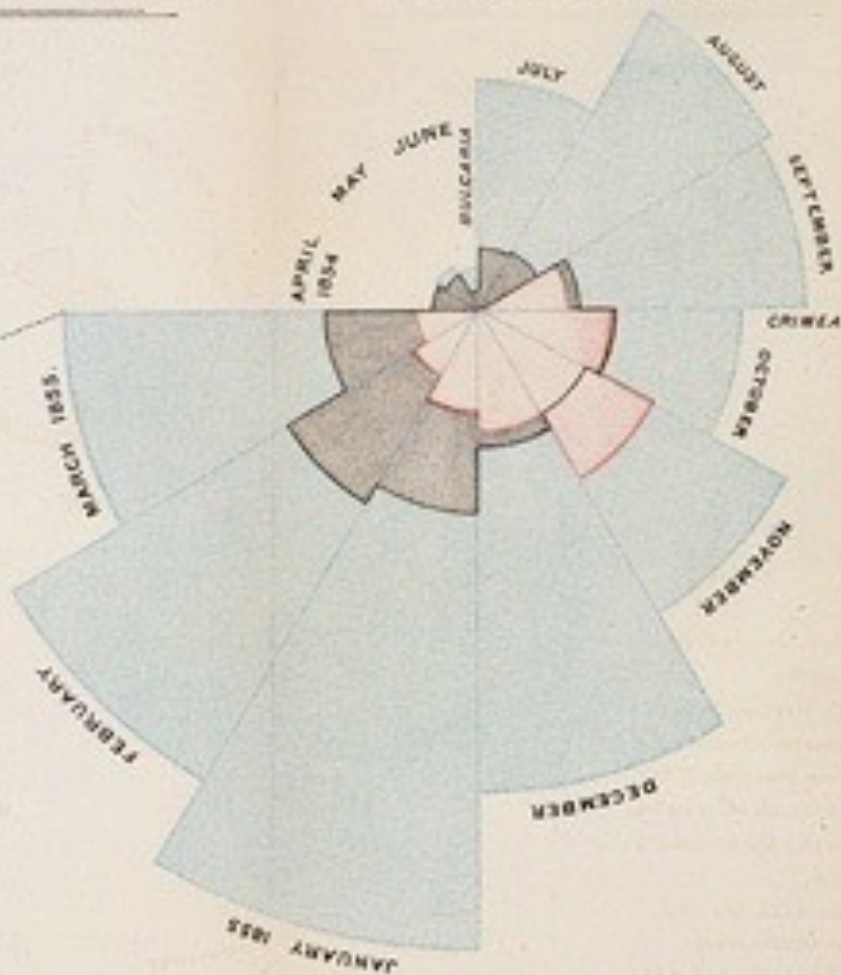
Automatic augmentation for communication

Collaborative visualization

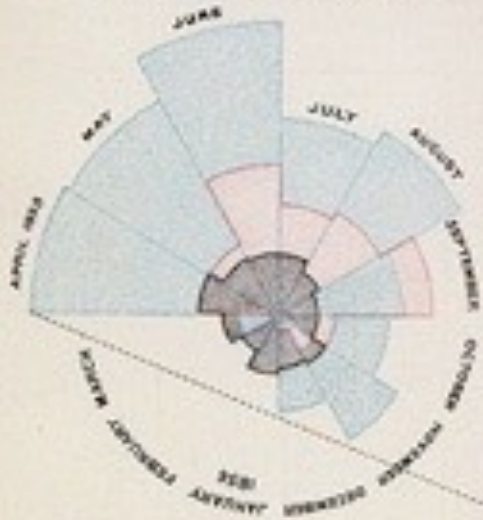
**Storytelling  
... with data?**

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

1.  
APRIL 1854 TO MARCH 1855.

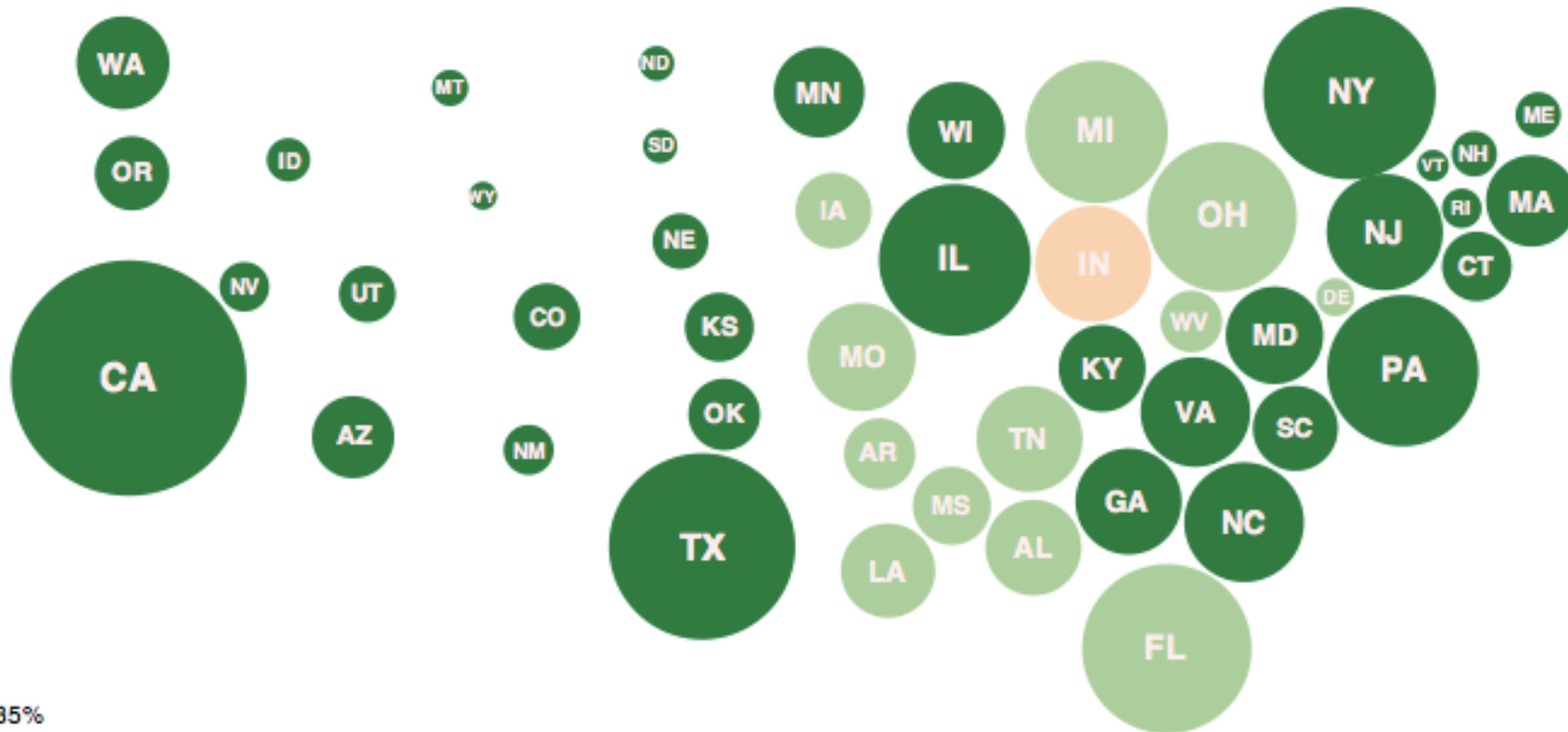


2.  
APRIL 1855 TO MARCH 1856.

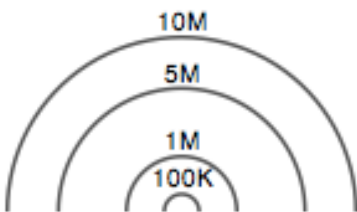


"to affect thro' the Eyes  
what we fail to convey  
to the public through  
their word-proof ears"

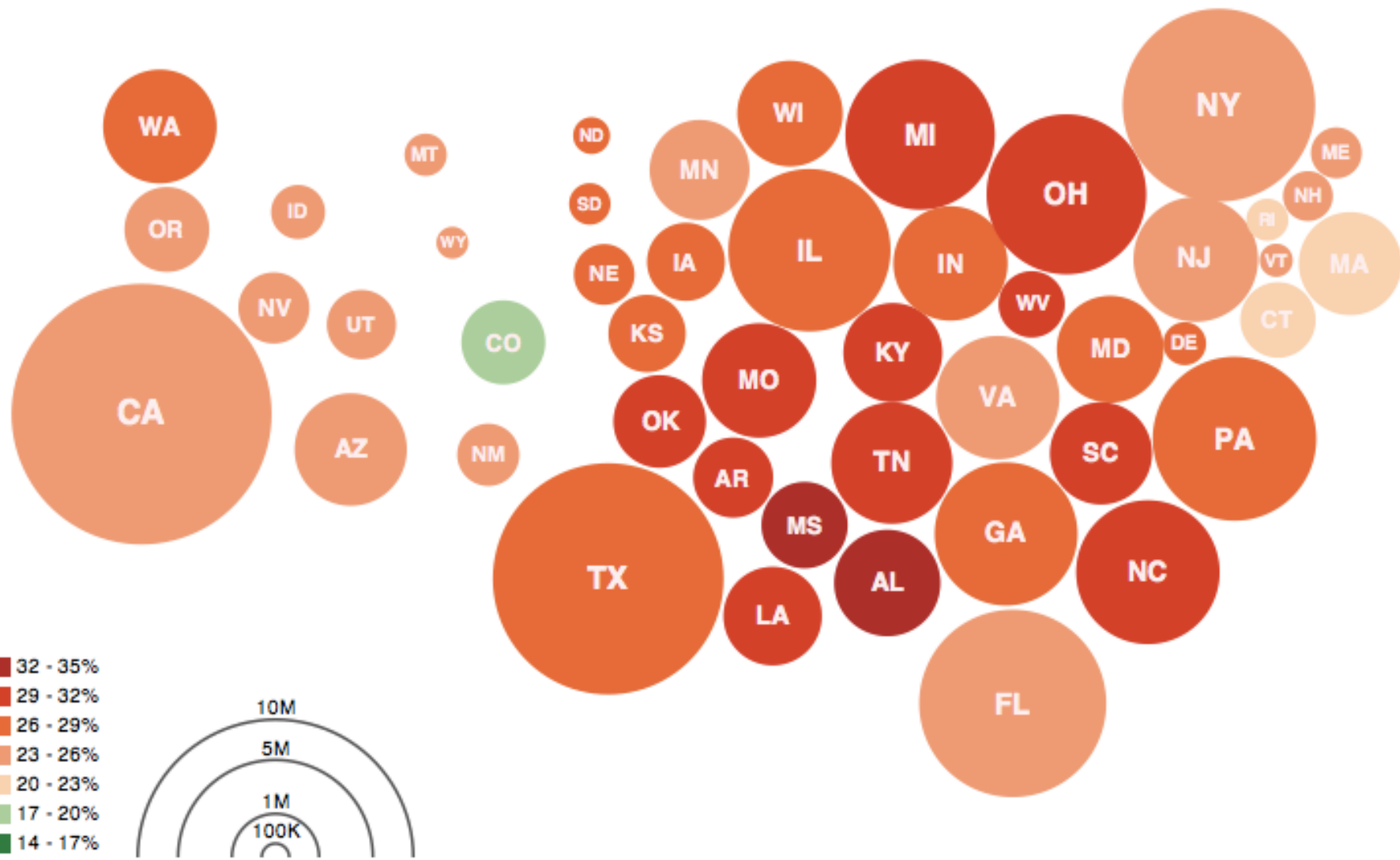
1856 "Coxcomb" of Crimean War Deaths, Florence Nightingale



- 32 - 35%
- 29 - 32%
- 26 - 29%
- 23 - 26%
- 20 - 23%
- 17 - 20%
- 14 - 17%

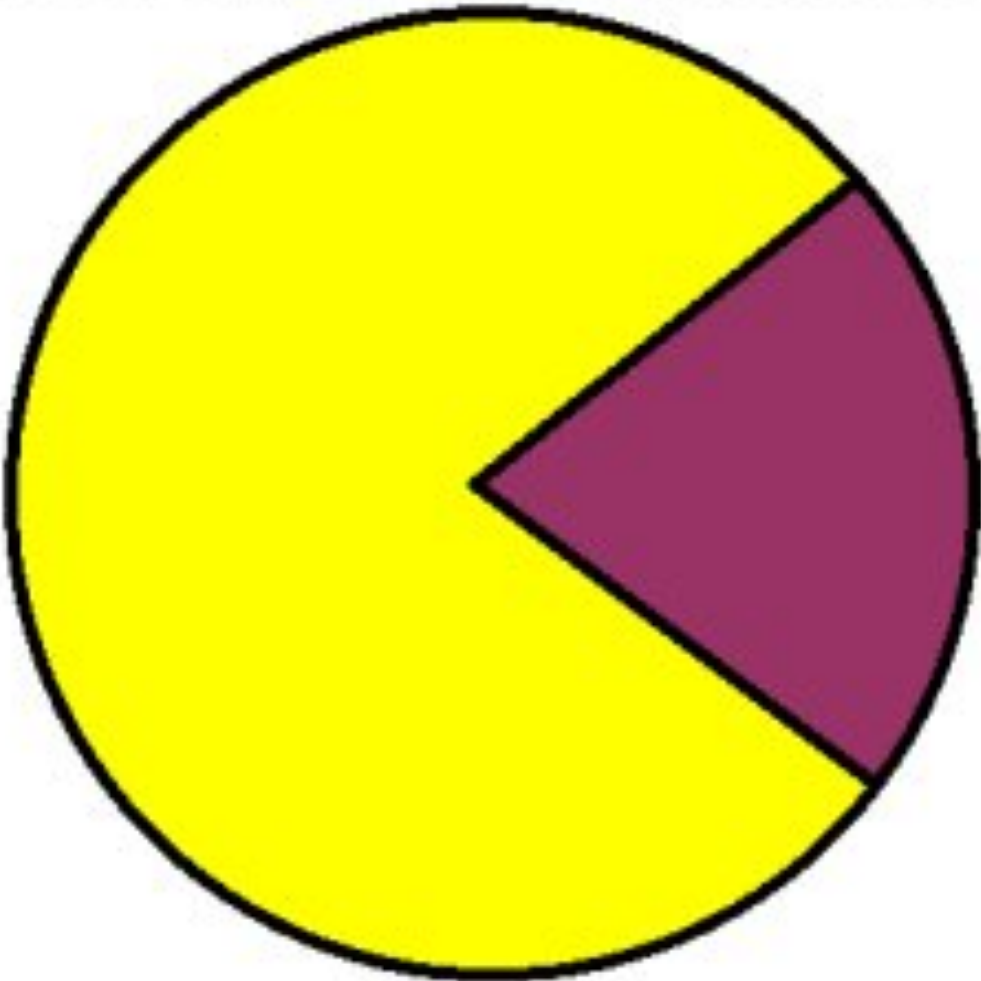


Obesity Map Vadim Ogievetsky



Obesity Map Vadim Ogievetsky

# Percentage of Chart Which Resembles Pac-man



- Resembles Pac-man
- Does not resemble Pac-man





Privacy and the internet  
Lives of others

OWNERS OF THE INTERNET  
Techs look and Google face a backlash, from users and regulators alike, over the way they have handled sensitive data

**J**OHNNIE STOCOMBE, Canada's privacy commissioner, is in talks with Facebook in August over the social networking site's track record, agreeing to change its policies within a year to comply with the country's privacy law, says Ms Stocome. The company appears to be coming out on an important part of the deal, which involved giving users a clear and easy-to-understand choice over whether to transmit data with third parties. "It doesn't seem to me that Facebook is going to be right to opt out of this issue," she says, noting that, 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 endured scathing criticism this week following news that it had accessed some personal communications sent over unsecured Wi-Fi data networks in homes and offices in some 30 countries. On May 11th Peter Schaar, Germany's federal commissioner for data protection, called for an independent investigation into Google's behaviour, 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 concern among web users about how private data are made public. Several government interven-

ty in such as Cory Doctorow, a science-fiction author, and Iain Stewart, a politician, have abandoned Facebook. Since such as Quora's founder, Doug Engelbart, swapped offices to start, announcing May 2nd for a mass Facebook "boycott".

This is unlikely to stop the momentum of Facebook, which is poised to claim half a billion members and which drove even more visitors as a whole to its site last month. Firm revenues have been raised at the company's headquarters in Menlo Park, where bosses are meeting over how to respond. Several online 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 to an extent to woo disaffected Facebookers to its service.

A revolt over Facebook's handling of privacy has been brewing 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 frustrated privacy activists lobbied hard to be reversed.

The switch should not have come as a surprise: rarely do many social networks

Also in this section

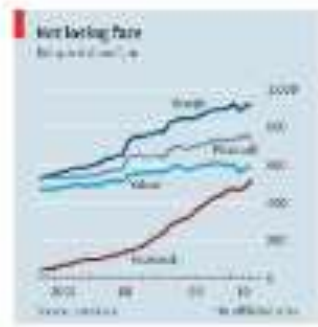
- 68 Spring companies
- 80 The recovery of General Motors
- 86 Business crime in China
- 70 Italian retail
- 70 Japan's drug firms are the model
- 74 Brazil's tabacaria
- 74 Schumpeter: Duernsmethod

By Julia Purdy and James O'Connell, and  
dominiq.com/business-views

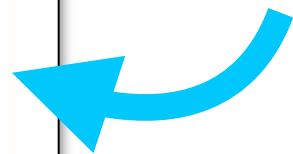
reportedly tough privacy policies in order to attract and increase users. But as more joint controls are gradually loosened to encourage more sharing, as people share more, Facebook can increase the traffic against which it sells advertising. And the more it learns about users' likes and dislikes, the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

Privacy groups have still following a developers' conference last month at which Mark Zuckerberg, Facebook's boss, announced yet another series of policy changes. One that raised irritation was an "instant personalisation" feature that lets remote third-party websites access Facebook data when people visit. Critics say that Facebook has made it risky to disable this feature, which may explain why its similar Facebook is so much.

Support of the idea are generating both Facebookers too. This month a group of distinguished experts who advise the European Commission wrote to the social network, calling for it to set an industry default settings "as accessible" and to the



small support afterthought boring?



Published: February 2, 2010

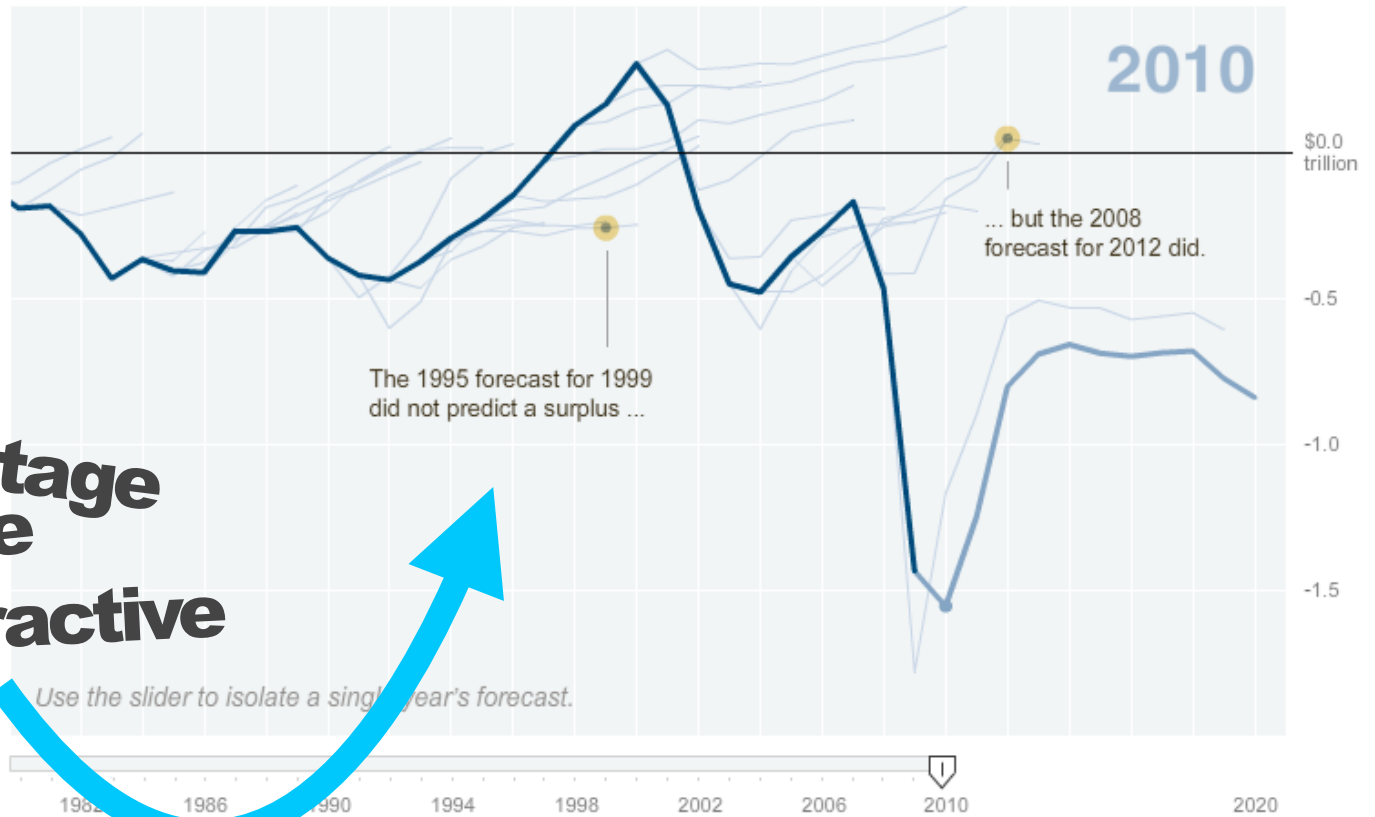
## Budget Forecasts, Compared With Reality

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 ▶

### Latest forecast

Today, with a better understanding of the severity of the economic downturn, the deficit situation is much more dire.

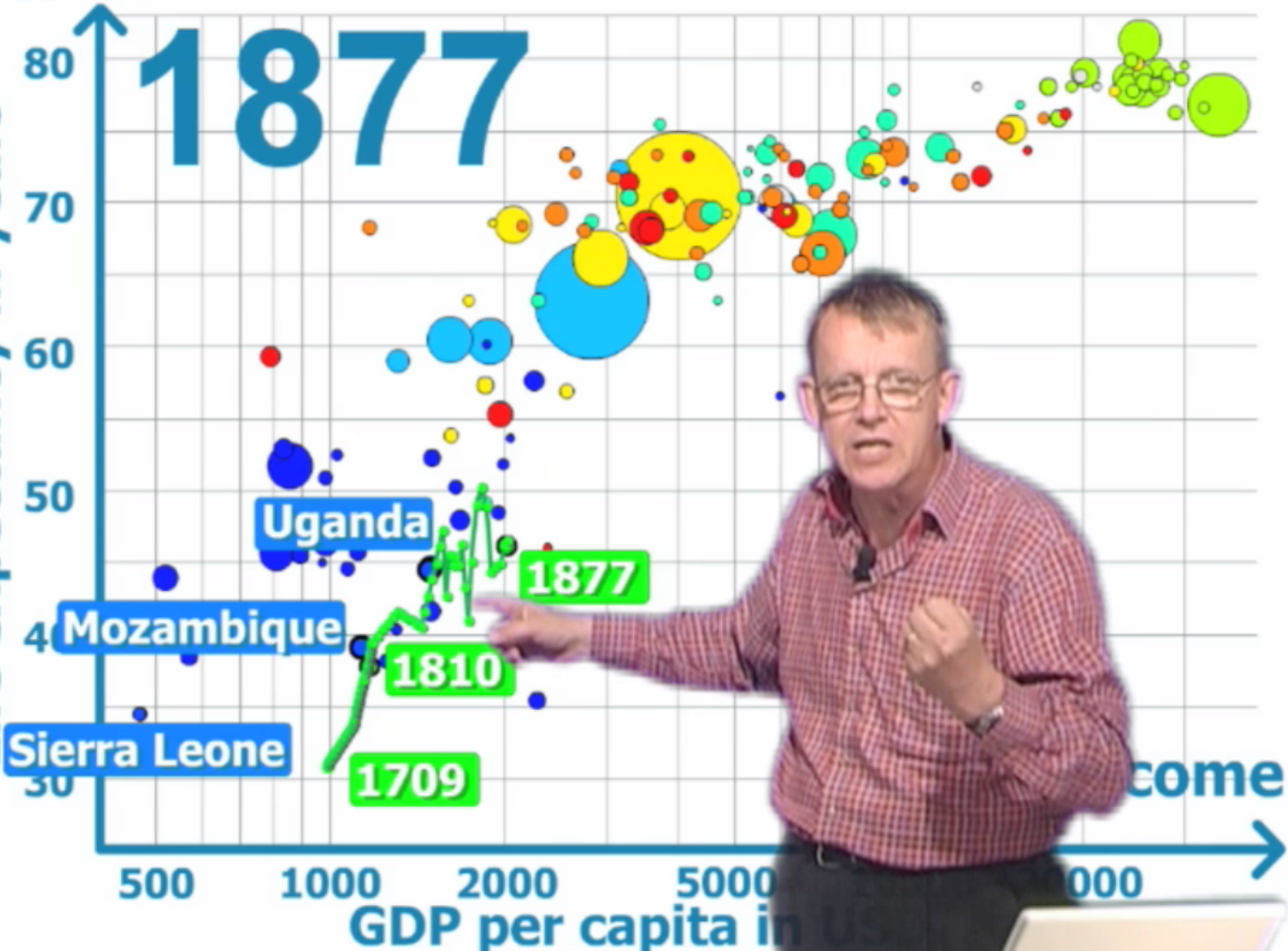


**center stage**  
**standalone**  
**interactive**  
**guided**

Health

Life expectancy in years

1877



Income

GDP per capita in US\$



Holograms?

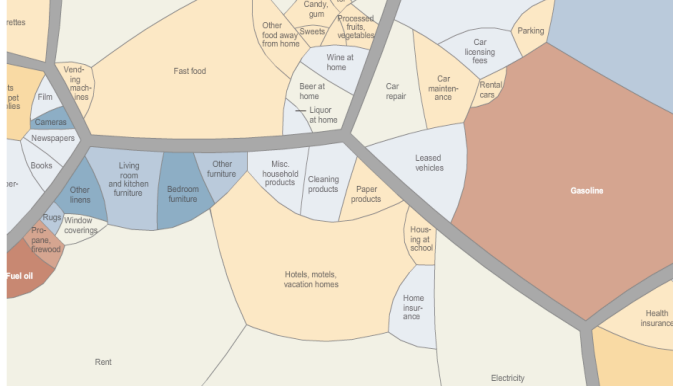
Narrator

# Narrative Devices for Storytelling with Data

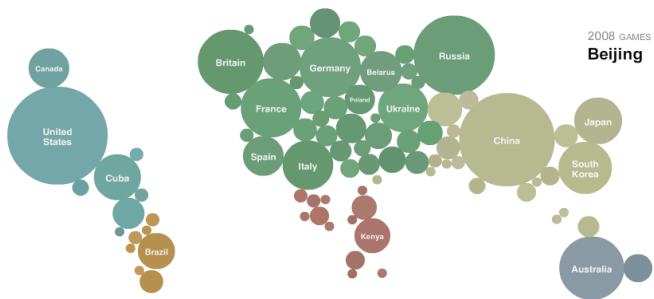
What devices communicate effectively?

... for which contexts and audiences?

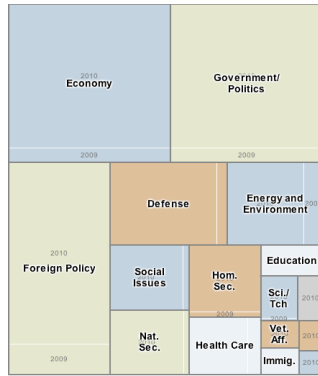
# Narrative Visualization Design Space



GEOGRAPHIC VIEW BY RANKING  
1896 1900 1904 1908 1912 1920 1924 1928 1932 1936 1948 1952 1956 1960 1964 1968 1972 1976 1980 1984 1988 1992 1996 2000 2004 2008



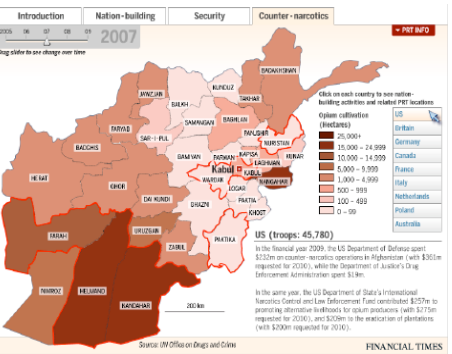
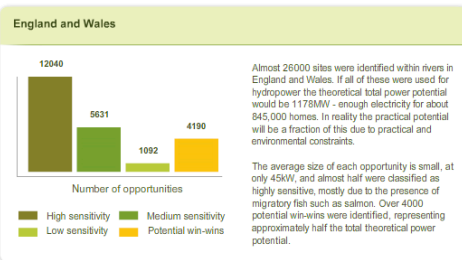
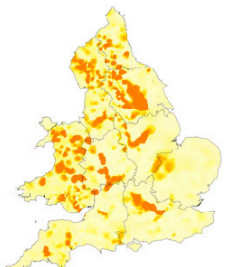
2008 Medal Count



# 58

## CASE STUDIES

- 70% Journalism
- 20% Business
- 10% Research

# 755

Grab attention with image and position



Line chart showing cumulative home runs.

**Hank Aaron**  
755 homers  
23 seasons



**Babe Ruth**  
714 homers  
22 seasons



**Barry Bonds**  
708 homers  
20 seasons

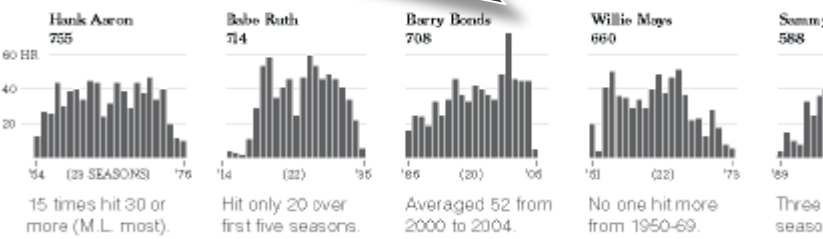
**Bonds takes lead**  
Home runs after 16 seasons  
Bonds 567  
Aaron 554  
Ruth 516

Major concern

According to a book, he began using steroids in the 1990s, league-wide later, he runs, su career p

Reduced visual priority

Differing Paths to the Top of the Charts The top seven players on the career h

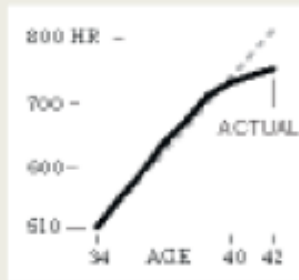


## Homer Pace After Age 34

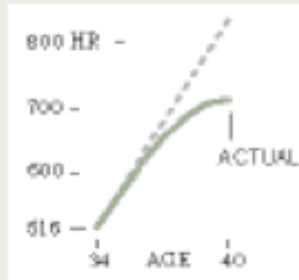
If the accusations are correct, Bonds was 34 in his first season on steroids. Here are projected home run paces for each player after age 34.

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

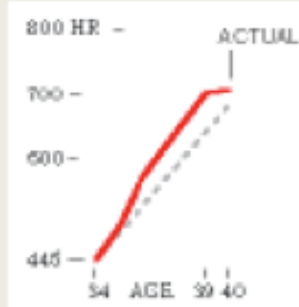
**Aaron**  
Actual homers slightly outpace projected homers for five seasons.



**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.

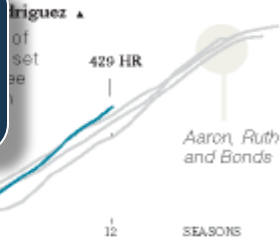


Note: Ages as of July 1 of each season.

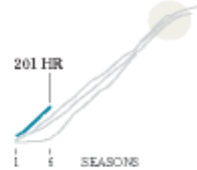
## Others Taking Aim



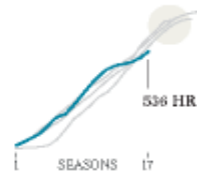
Force



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

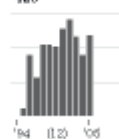


**Ken Griffey Jr.**  
Many thought he would be the first to catch Ruth and Aaron until injuries limited his output.



(257th).

**Alex Rodriguez**  
429



Youngest to reach 400 homers.

**Albert Pujols**  
201



Second most ever in first five seasons.



# Beginning

## Steroids or Not, the Pursuit Is On

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

These are cumulative home runs.

**Hank Aaron**  
755 homers  
23 seasons



**Babe Ruth**  
714 homers  
22 seasons



**Barry Bonds**  
708 homers  
20 seasons

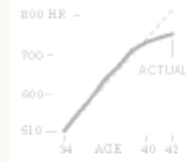
**Bonds takes lead**  
Home runs  
after 16 seasons:  
Bonds 567  
Aaron 554  
Ruth 511

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

### 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.

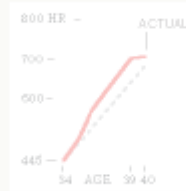
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**Bonds**  
From age 35 to 39, he averaged 14 more homers a season than projected.



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.

# Middle

## 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.

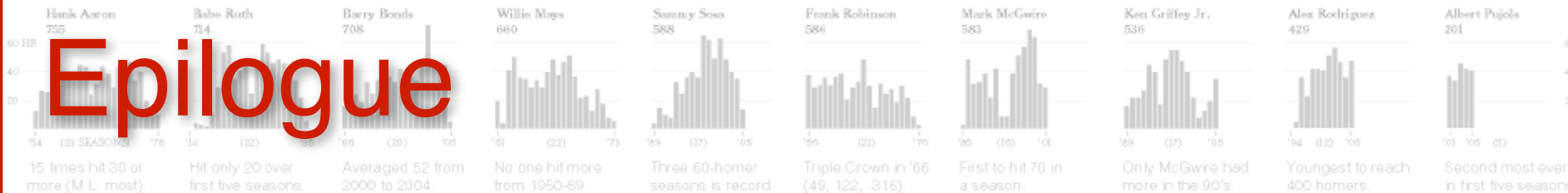
Many thought it would be the first to catch Ruth and Aaron until injuries limited his output.



# End

## 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).



# Epilogue


Establishing Shot

# Development Trends 2005



Checklist Structure

Interactive presentation of some of the messages in the Human Development Report



**1 Income**  
World population 6.1 billion  
2000  
Income is very unequally distributed across the world

**2 Regions**  
Number of people on different income levels by region, in 2000  
South Asia  
East Asia  
Latin America  
OECD  
Sub-Saharan Africa

**3 Poverty**  
2000  
South Asia  
East Asia  
Latin America  
OECD  
Income below one dollar per day

**4 Health**  
2003  
South Asia  
East Asia  
East Europe  
Latin America  
OECD  
Sub-Saharan Africa

**5 Countries**  
Child mortality (%)  
2003  
Sub-Saharan Africa  
OECD  
North America



**6 Differences**  
Child mortality (%)  
2003  
West Africa  
OECD  
East Africa

**7 Trends**  
Child mortality (%)  
2003  
OECD  
Sub-Saharan Africa


**8 Gaps**  
Child mortality (%)  
2003  
OECD  
Sub-Saharan Africa

**9 Deaths**  
Deaths of children under age 5 (million)  
2003

English translation: Claes Johansson, UNDP

Produced in collaboration with:   [www.hdr.org](http://www.hdr.org)

English translation: Claes Johansson, UNDP

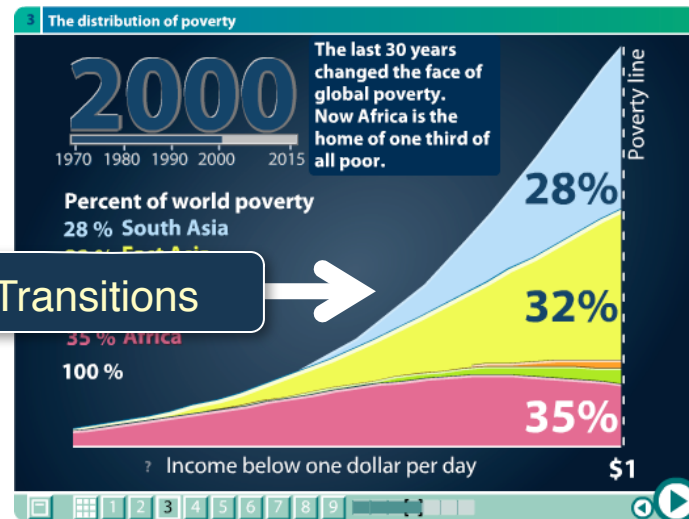
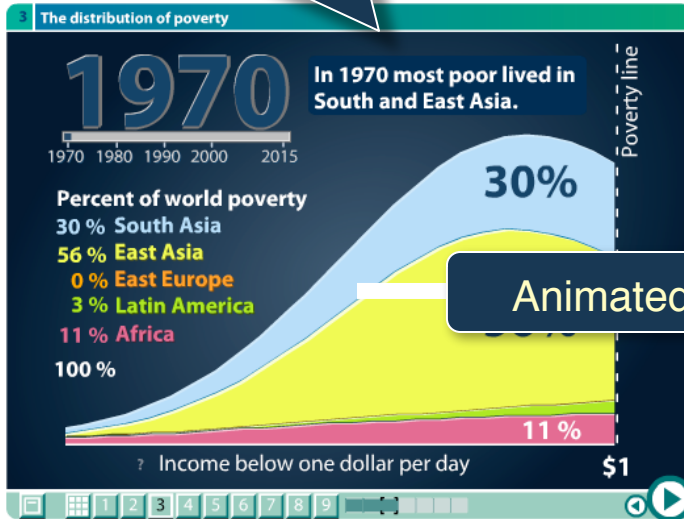
Start 

Progress Bar: 1 2 3 4 5 6 7 8 9

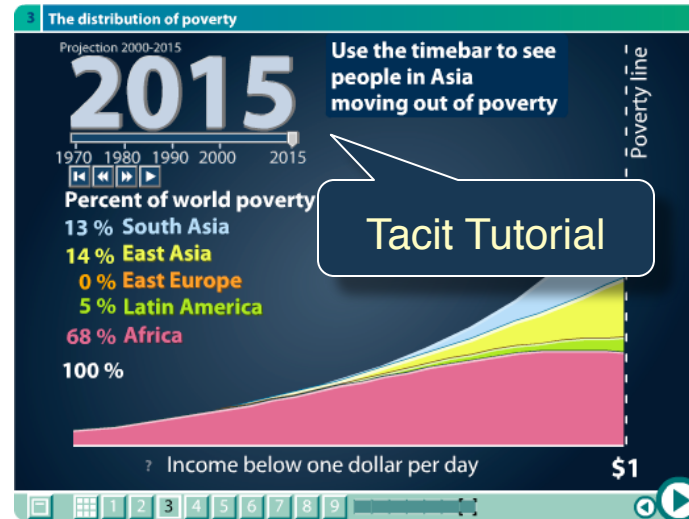
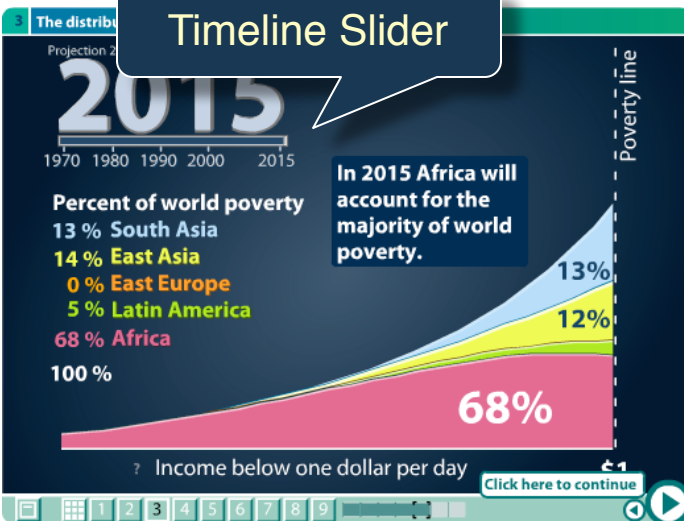
Progress Bar

Cue to Action

# Annotations Tell Story



# Animated Transitions



# Interactive Slide Show

# Budget 2010: reaction from around the UK

People in key constituencies around the country give their responses to Alistair Darling's budget

by **Andy Ridley** and **Carly Lev**  
Wednesday 24 March 2010 15:00 GMT

**Smith and Fulham**



**Shilpa Wymer**, 40, is managing director of two branches of Pitman Training Ltd, a training school specialising in secretarial and PA training

Enquiries from individuals suddenly dropped off a cliff from October 2008 and in January last year we had to lay off a couple of people, though things have picked up since. The budget seems very positive and shows the government are thinking about small and medium sized businesses at last. I think the measures will help businesses be more confident, which will have a knock-on effect on us. It has turned my head and made me think about which way I will vote.

## Constituency profile

MP: Greg Hands, Conservative. Majority: 5,029  
Unemployment benefit claimants, Feb 2010: 3,281 (up 13% over last year)

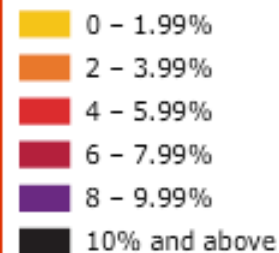
Introductory Text

Consistent Visual Platform

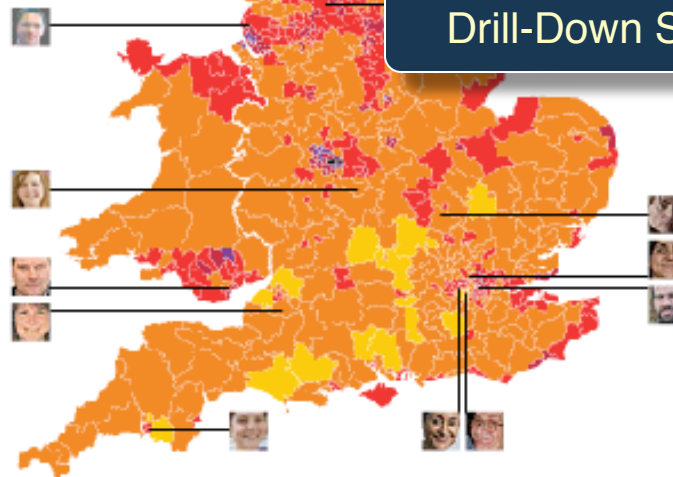
Anecdotal Stories with Data Stories

## Key

Unemployment benefit claimant count, February 2010

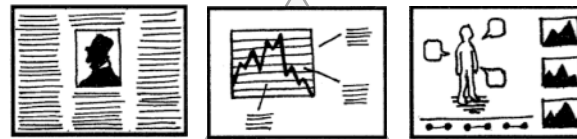


Drill-Down Story





# Visual Design



MAGAZINE  
STYLE

ANNOTATED  
CHART

SCIENCE FAIR  
POSTER



FLOWCHART

COMICSTRIP

SLIDESHOW

MOVIE

Duo-Specific

Captions

Annotations

Attached  
Article

Summaries

Interpret

Headlines

Tacit  
Tutorial

Selection

Navigation

Details on  
Demand

Timelines

Filtering

Highlighting

## Messaging

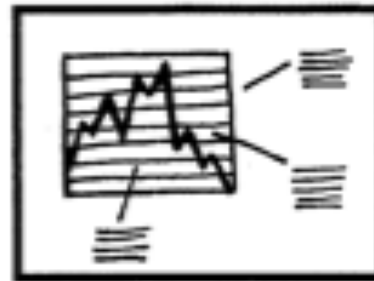
## Interactivity

MORE

# Seven Genres



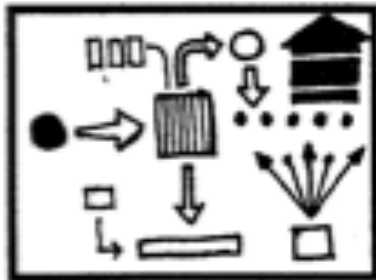
Magazine Style



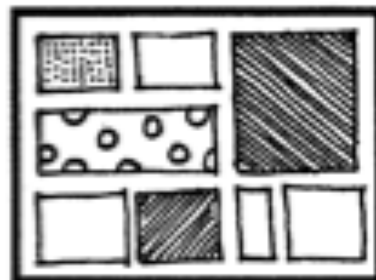
Annotated Chart



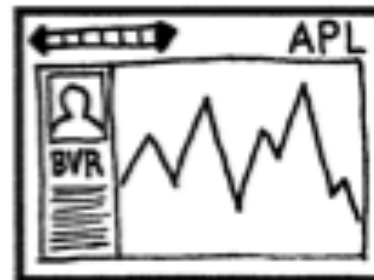
Partitioned Poster



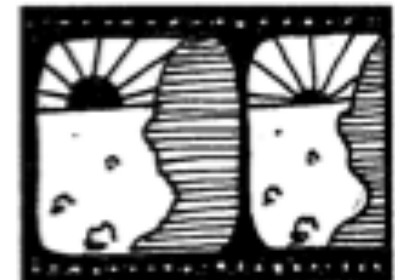
Flow Chart



Comic Strip



Slide Show



Film/Video/Animation

## Genres for Narrative Visualization (2010)

*Missing "scrolly-telling" designs...*

# Genres + Interactivity + Messaging =

# DESIGN SPACE

STORYTELLING

CLARITY

SPEED

## Author Driven

strong ordering  
heavy messaging  
limited interactivity

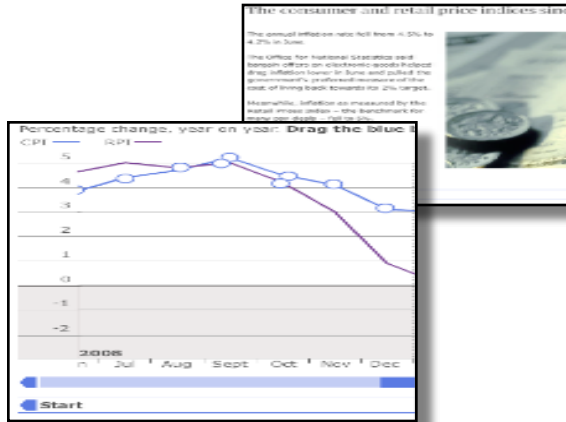
## Reader Driven

weak ordering  
light messaging  
free interactivity

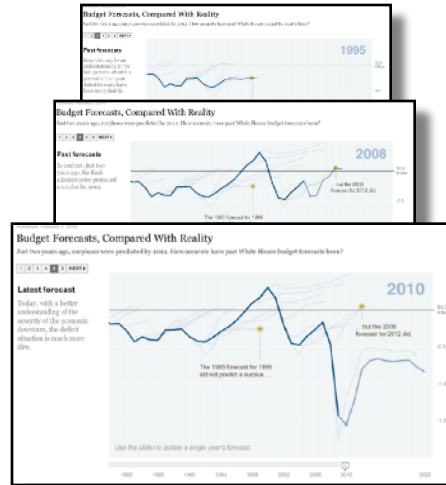
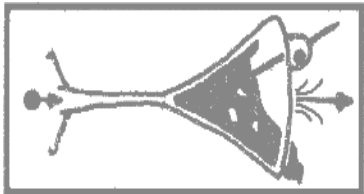
ASK QUESTIONS

EXPLORE

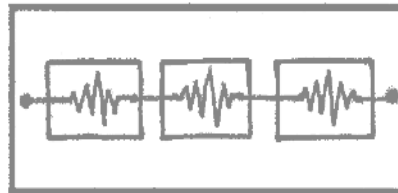
FIND



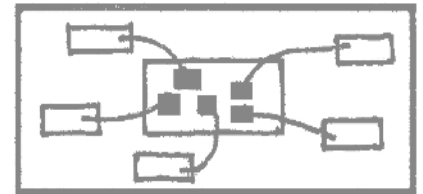
martini glass



interactive slideshow



drill-down story





# Interactive Documents: Steppers, Scrollers, ...

Published: February 2, 2010

# Budget Forecasts, Compared With Reality

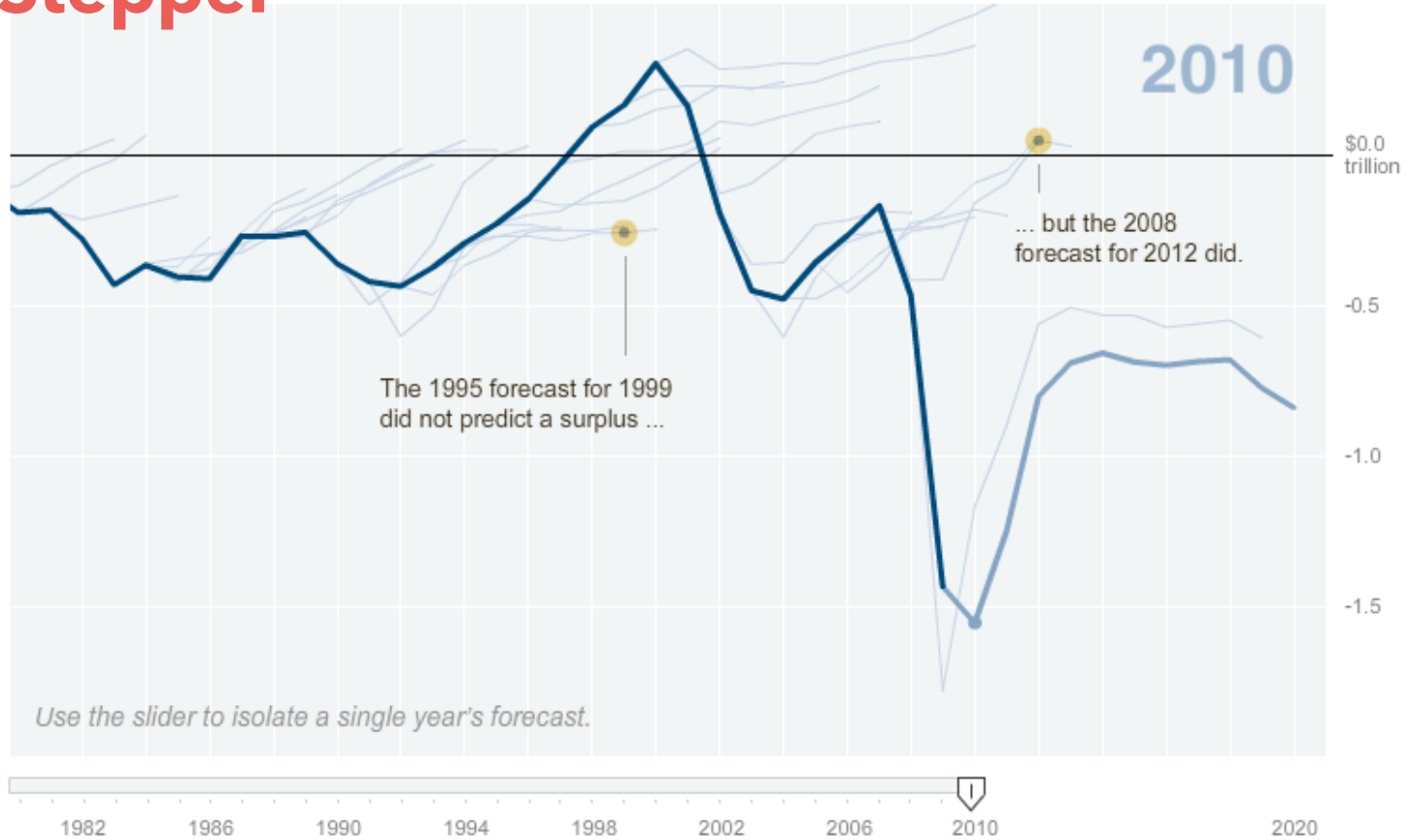
Just two years ago, surpluses were predicted by 2012. How accurate have past White House budget forecasts been?

1 2 3 4 5 6 NEXT ▶

## Latest forecast

Today, with a better understanding of the severity of the economic downturn, the deficit situation is much more dire.

# Stepper



### Ramadi: The Government Provides an Opening for ISIS **ISIS Control**

Tensions between this city's residents, who are mostly Sunni, and the central government had been brewing here for at least a year. Then in December, Iraq's prime minister, Nuri Kamal al-Maliki, ordered security forces to dismantle a protest camp — an outlet for disenchanting Sunnis angered at their treatment by the Shiite-dominated government. The action ignited days of violence and created the opening ISIS needed to seize parts of the city, the provincial capital.

Lake Tharthar

### Falluja: A Symbolic Fall **ISIS Control**

Just days after the raid on the camp in Ramadi, ISIS fighters destroyed the Police Headquarters and mayor's office here, planted their flag on government buildings and decreed the city to be theirs. Ten years earlier, American forces had captured this city from Qaeda-style insurgents at a considerable cost of American lives.

Lake Habbaniya

Balad



17 MILES TO BAGHDAD

Scroll



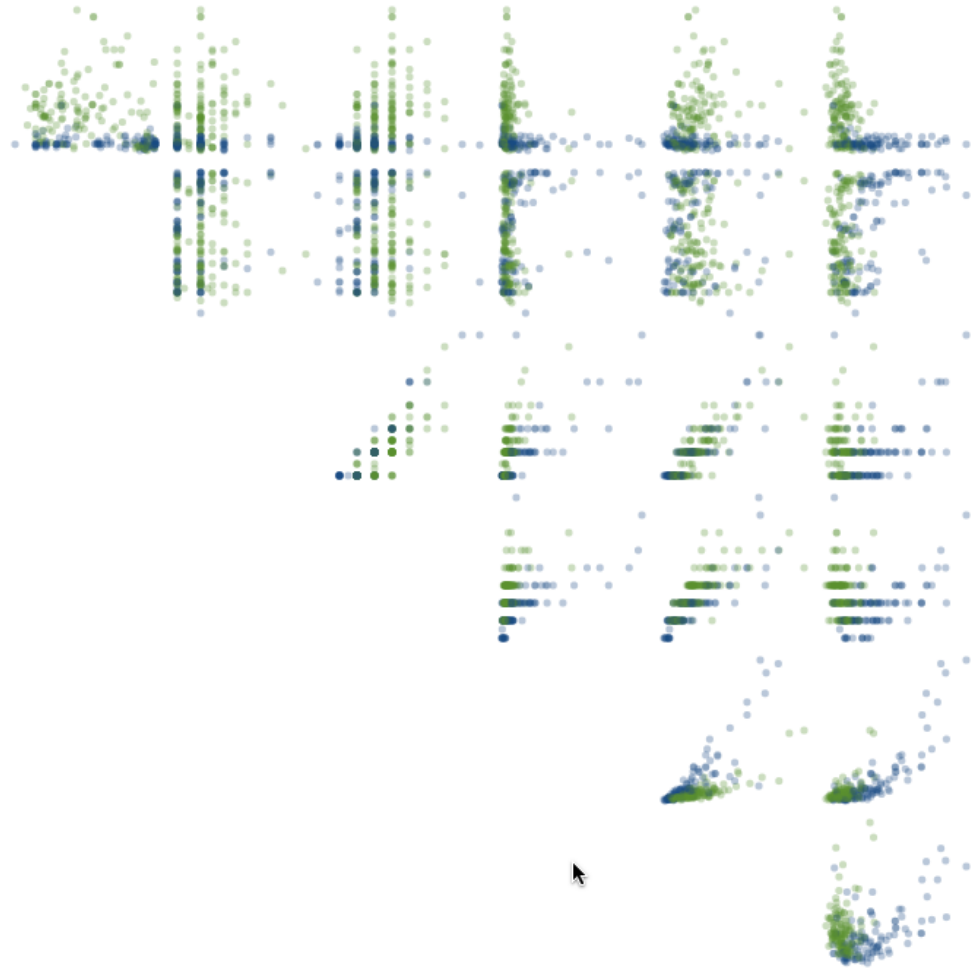
R2  
D3

# 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.



# Discrete step vs. Continuous scroll

Different means for narrative navigation.  
A source of debate among practitioners!

# Discrete step vs. Continuous scroll

Different means for narrative navigation.  
A source of debate among practitioners!

**Step:** sequential frames as in a slideshow  
Simple and familiar, but less engaging?

# Discrete step vs. Continuous scroll

Different means for narrative navigation.  
A source of debate among practitioners!

**Step:** sequential frames as in a slideshow  
Simple and familiar, but less engaging?

**Scroll:** continuous navigation of page  
Parameterize content by scroll position  
May cause usability / scrolljacking issues

# Discrete step vs. Continuous scroll

Different means for narrative navigation.  
A source of debate among practitioners!

**Step:** sequential frames as in a slideshow  
Simple and familiar, but less engaging?

**Scroll:** continuous navigation of page  
Parameterize content by scroll position  
May cause usability / scrolljacking issues

**Hybrids:** scroller with discrete sections



# Narrative Implementation

## **Do-It-Yourself**

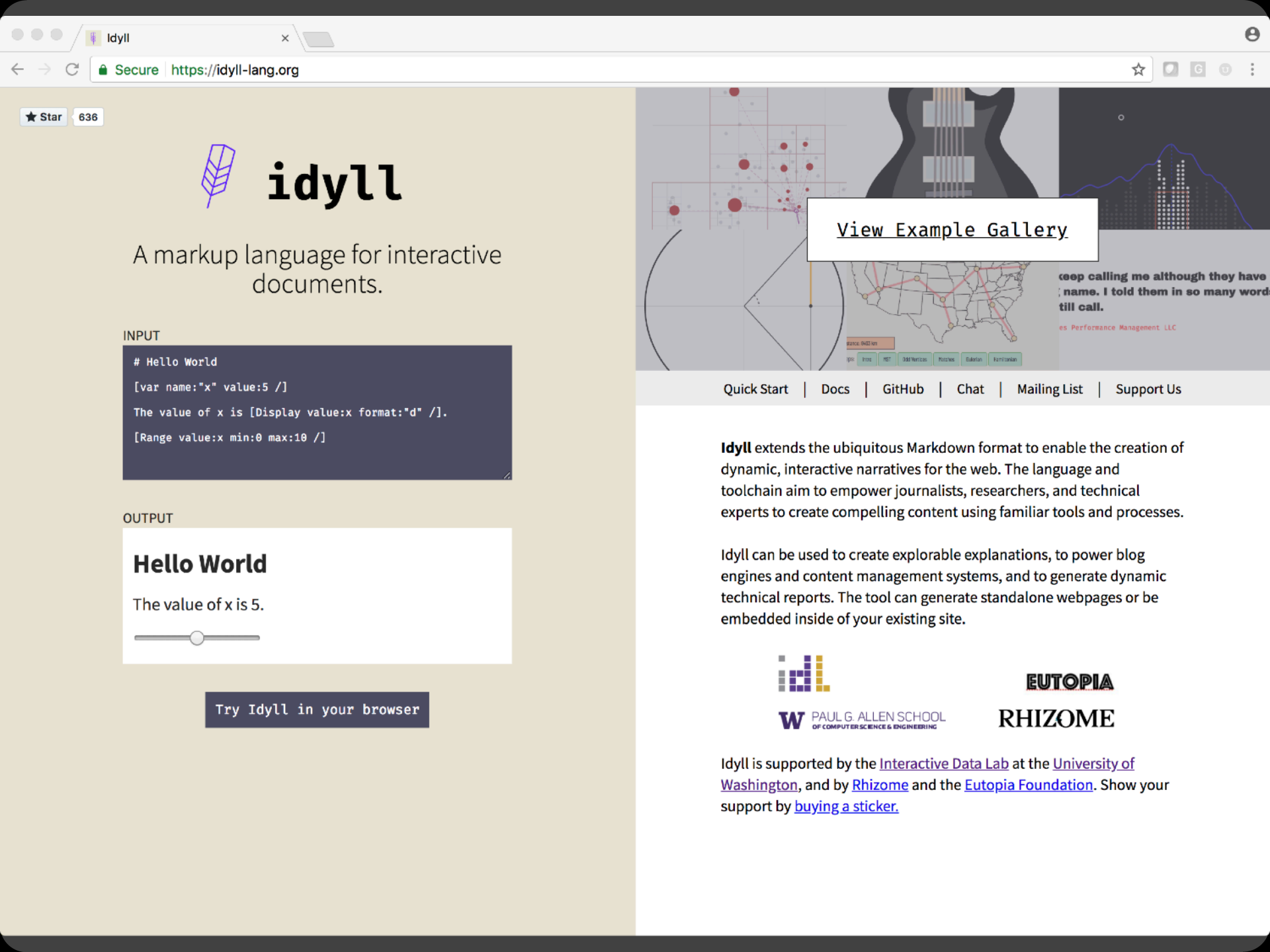
Monitor scroll position & element positions

Guidance: [M. Bostock](#), [J. Vallandingham](#)

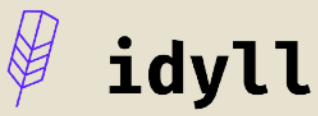
## **Third-Party Support**

Idyll: Markup for Interactive Documents

Scrolly Helper Libraries



★ Star 636



A markup language for interactive documents.

INPUT

```
# Hello World
[var name:"x" value:5 /]
The value of x is [Display value:x format:"d" /].
[Range value:x min:0 max:10 /]
```

OUTPUT

**Hello World**  
The value of x is 5.

Try Idyll in your browser

[View Example Gallery](#)

[Quick Start](#) | [Docs](#) | [GitHub](#) | [Chat](#) | [Mailing List](#) | [Support Us](#)

**Idyll** extends the ubiquitous Markdown format to enable the creation of dynamic, interactive narratives for the web. The language and toolchain aim to empower journalists, researchers, and technical experts to create compelling content using familiar tools and processes.

Idyll can be used to create explorable explanations, to power blog engines and content management systems, and to generate dynamic technical reports. The tool can generate standalone webpages or be embedded inside of your existing site.



PAUL G. ALLEN SCHOOL OF COMPUTER SCIENCE & ENGINEERING

EUTOPIA

RHIZOME

Idyll is supported by the [Interactive Data Lab](#) at the [University of Washington](#), and by [Rhizome](#) and the [Eutopia Foundation](#). Show your support by [buying a sticker](#).

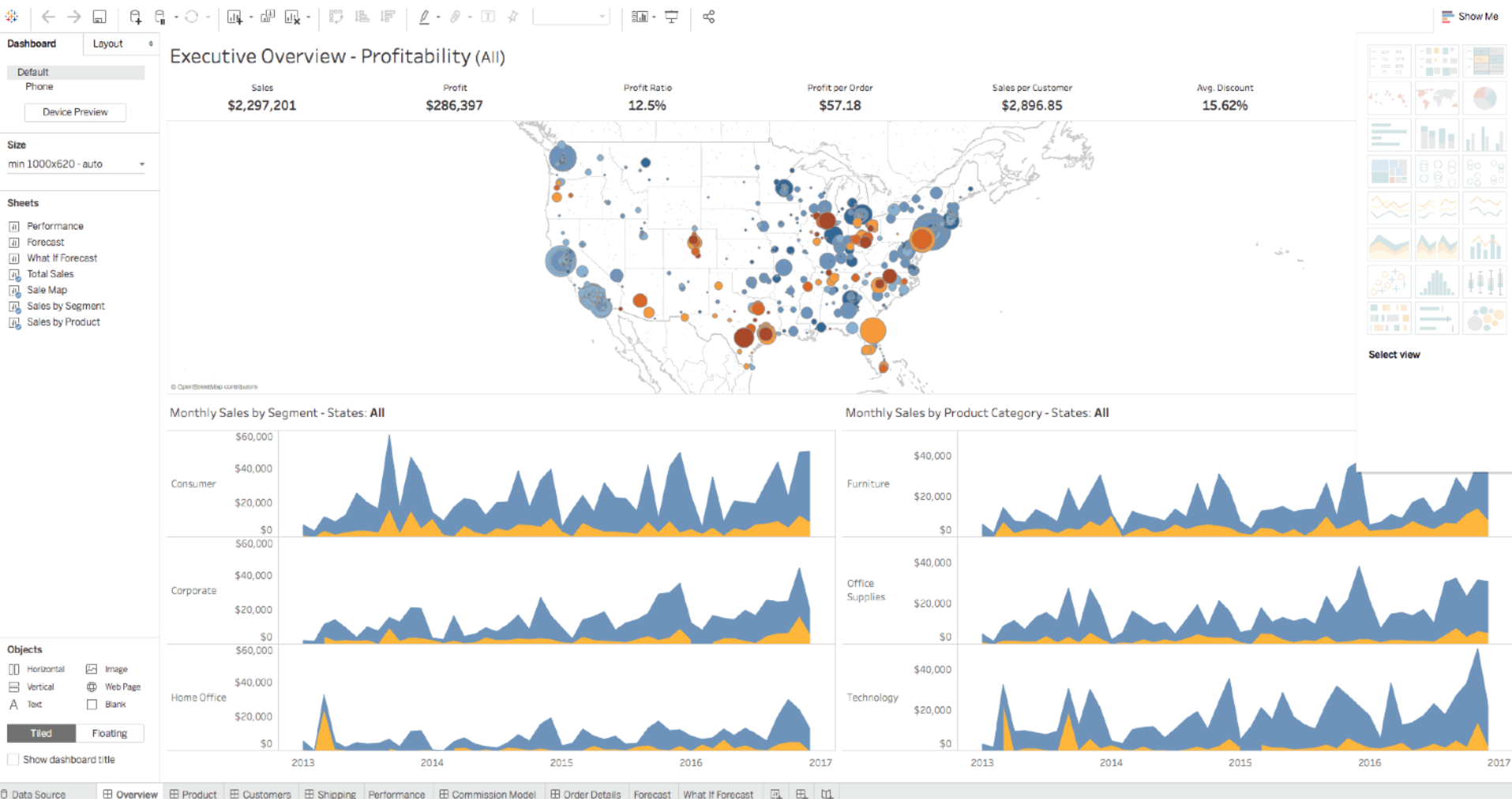
# Kernel Density Estimation

By: [Matthew Conlen](#)



# Chart Sequence Models

# Multiple Charts in Data Analysis



# Multiple Charts in Story Telling

## 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

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**

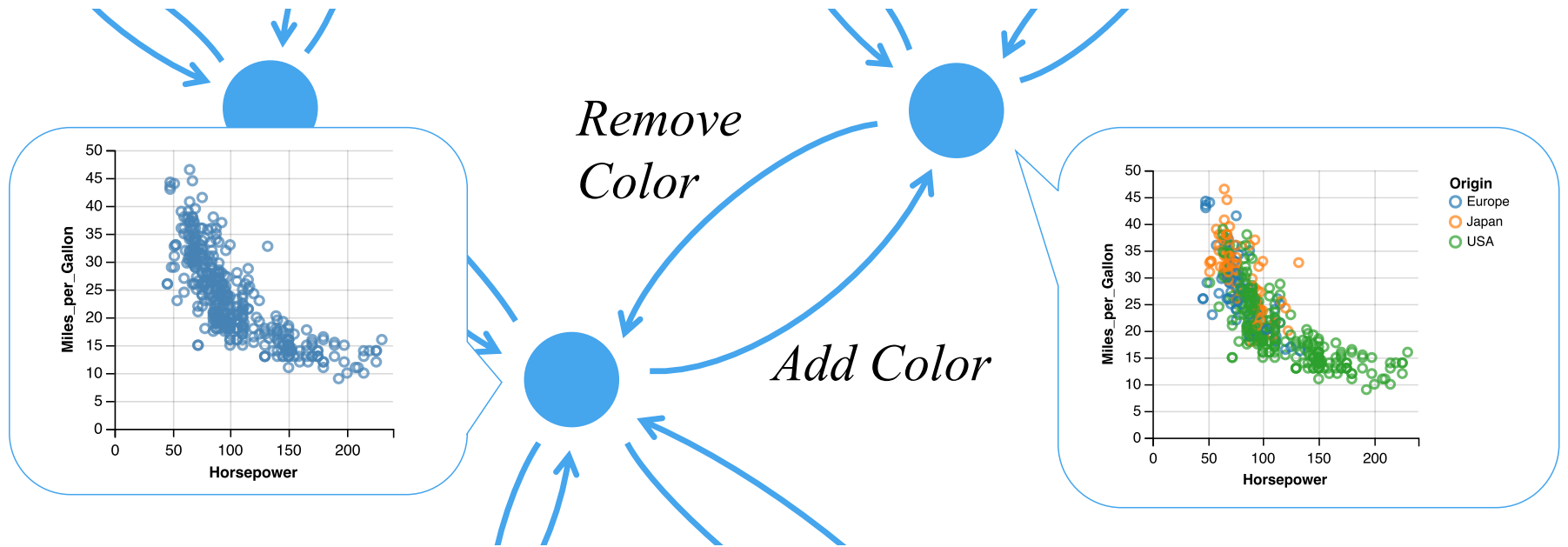


*Roll over countries to learn more*

**In many cases, data is conveyed  
via a sequence of charts.**

**How might we evaluate different  
orderings of visualizations?**

# GraphScape: A Directed Graph Model

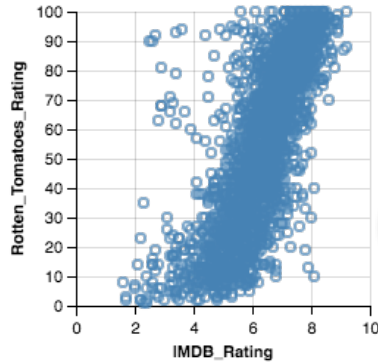
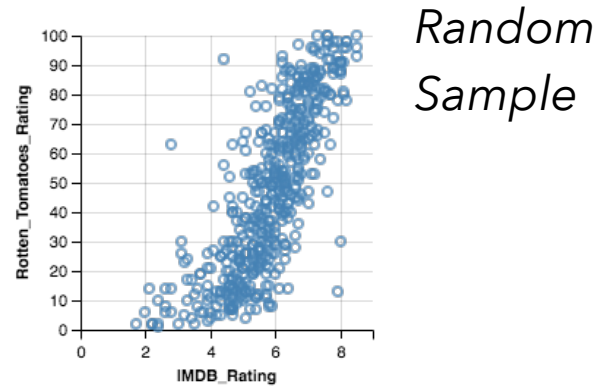


Nodes are Vega-Lite specifications. Edges represent **edit operations**, weighted by estimated **transition costs**.



# Design Alternatives

"Too many data points !"

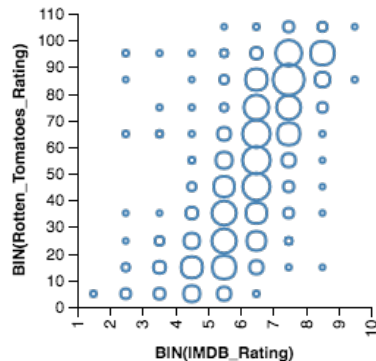


Add Filter

Bin

Bin

Binned Scatter Plot



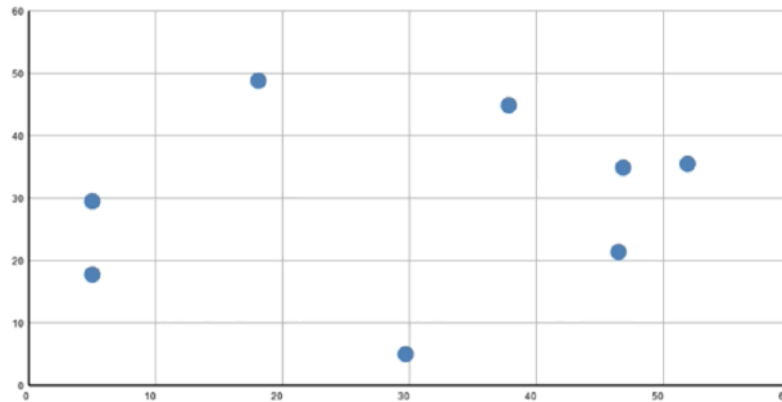
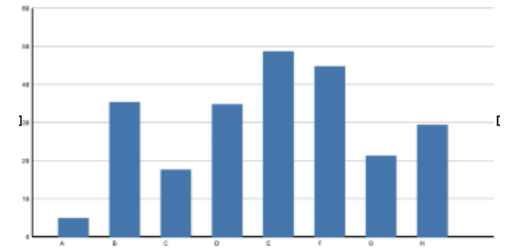
Add Size(count)

...

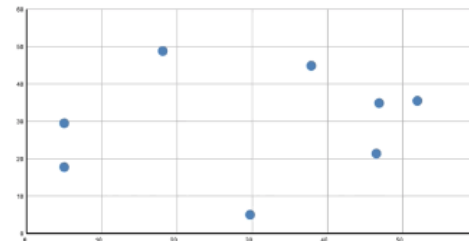
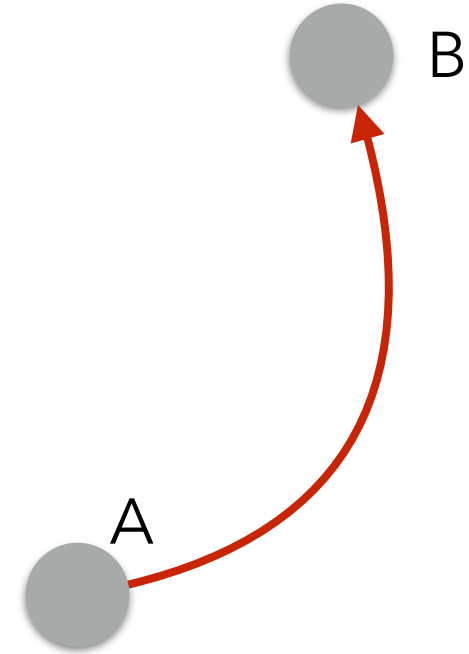
...

...

# Path Elaboration



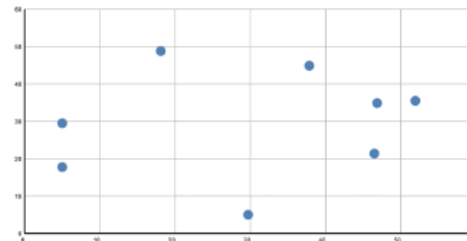
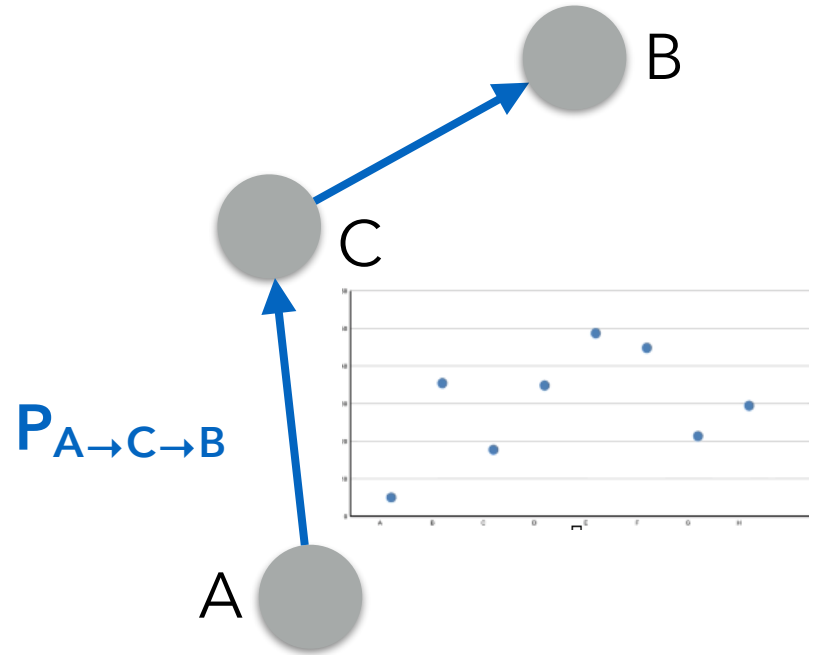
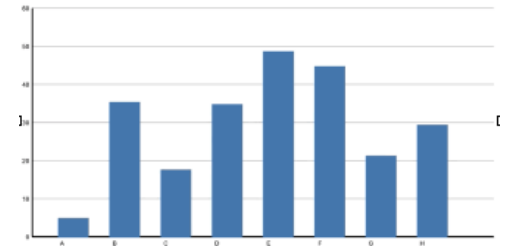
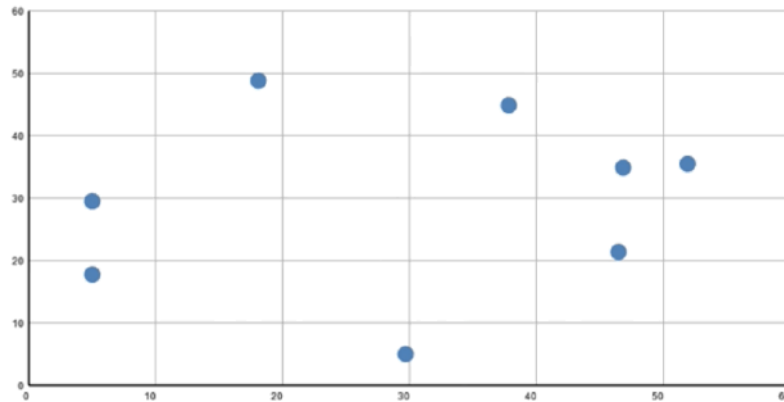
$P_{A \rightarrow B}$



Heer, Jeffrey and George G. Robertson.

"Animated Transitions in Statistical Data Graphics." *IEEE Trans. Vis. Comput. Graph.* 13 (2007): 1240-1247.

# Path Elaboration

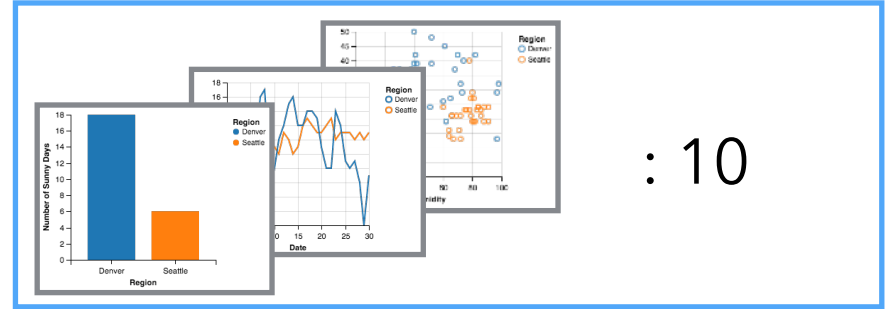
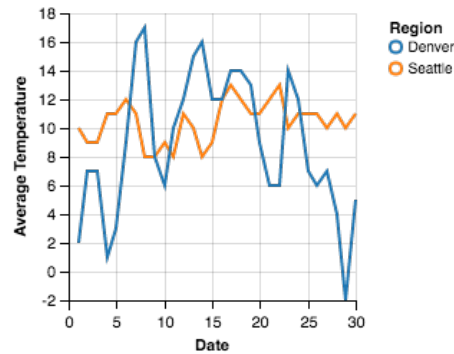
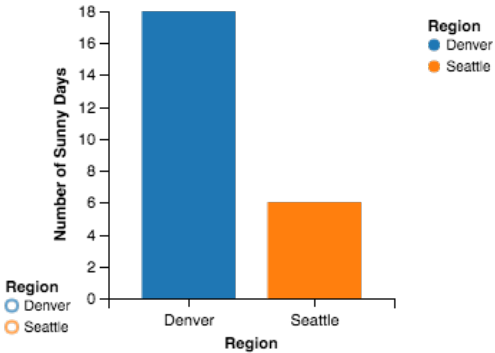
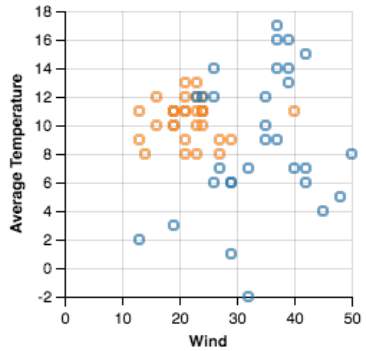


Heer, Jeffrey and George G. Robertson.

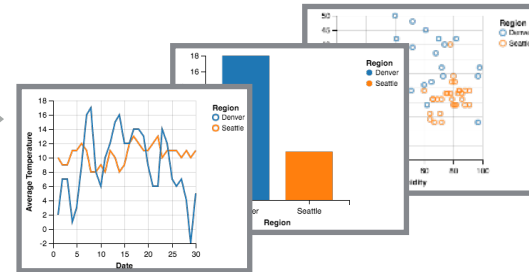
"Animated Transitions in Statistical Data Graphics." *IEEE Trans. Vis. Comput. Graph.* 13 (2007): 1240-1247.

# Sequence Recommendation

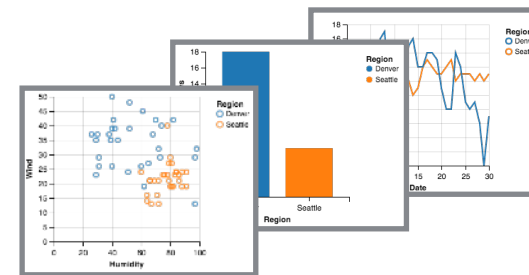
Sequence  
Cost



: 10



: 12



: 13

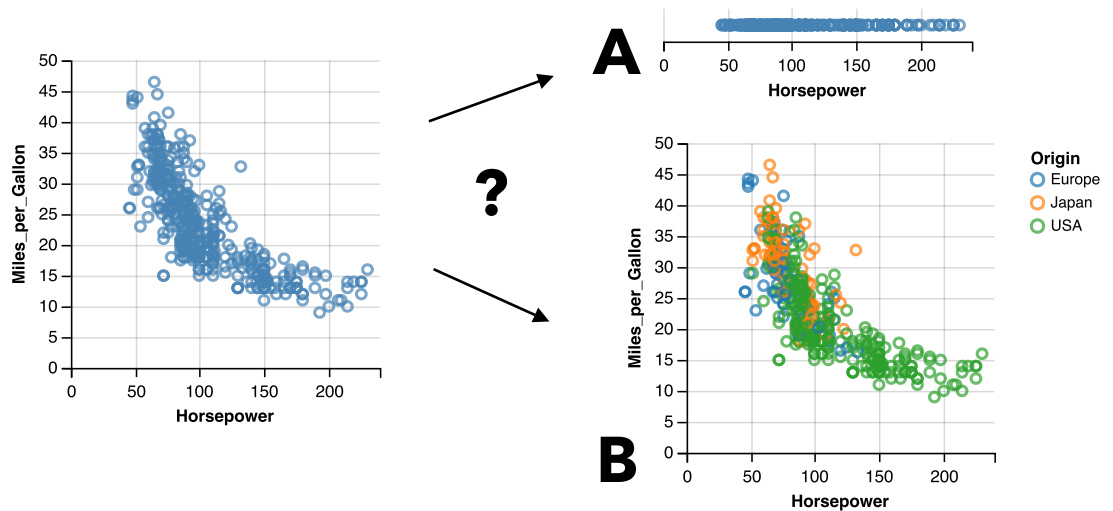
...

# Learning Edge Weights

Given a **reference chart**, what should come **next**?

Triplet judgments express **inequalities** among edits.

We encode these in a linear program. The solution gives us **cost estimates** for each edit operation type.



Asks the question:  
Is  $Drop Field_y < Add Field_{color}$ ?

# Sequence Cost Model

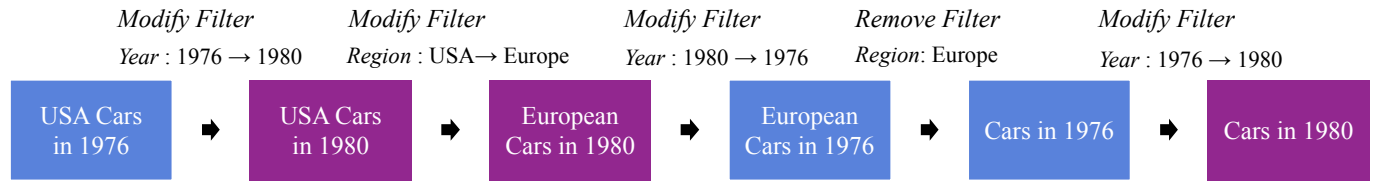
Chart Sequence



$Cost(S)$

) Cost

Sorted by  
Sum of Transition Costs



# Sequence Cost Model

Chart Sequence



$$\mathit{Cost}(S) =$$

Transition (Edit Distance) Cost



$$\sum_{i=1}^{|S|} T(S_{i-1}, S_i)$$



# Sequence Cost Model

Chart Sequence      Transition (Edit Distance) Cost

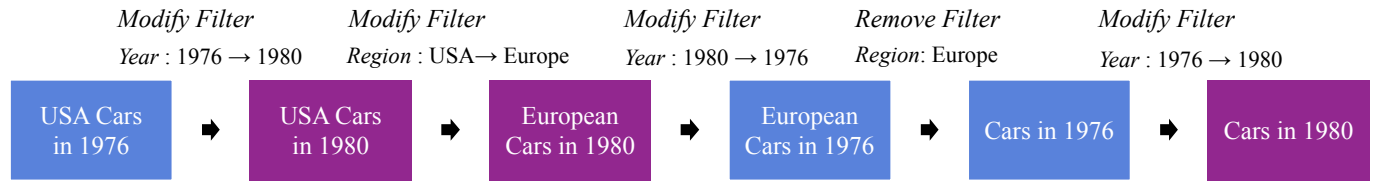
↓                                  ↓

$$Cost(S) = W(S) \cdot \left( \sum_{i=1}^{|S|} T(S_{i-1}, S_i) + F(S) \right)$$

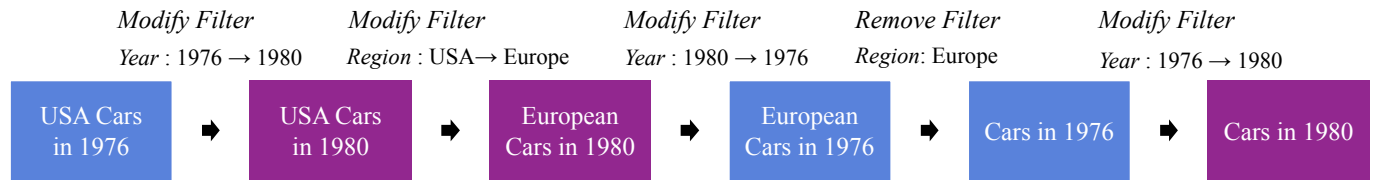
↑    ↑

Consistency Weight      Filter Cost  
(Promote Parallelism)

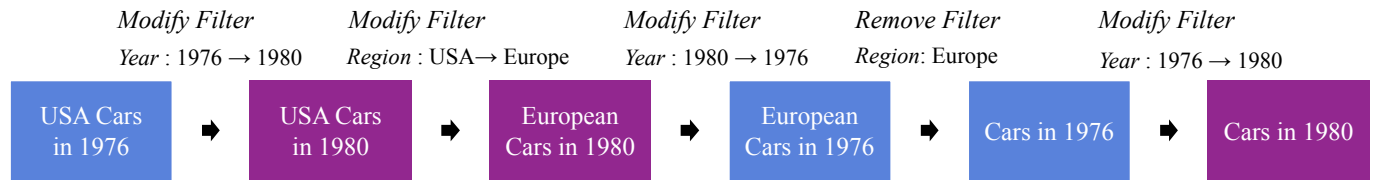
Sorted by  
Sum of Transition Costs



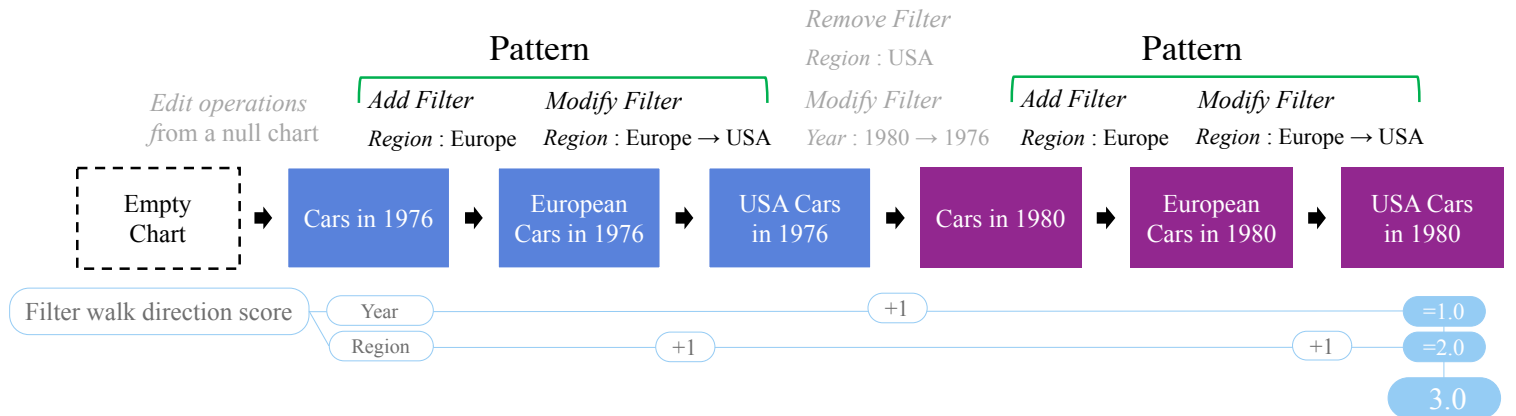
Sorted by  
Sum of Transition Costs



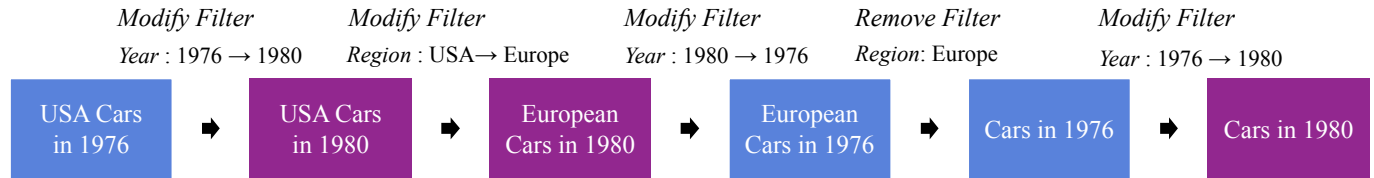
Sorted by  
Sum of Transition Costs



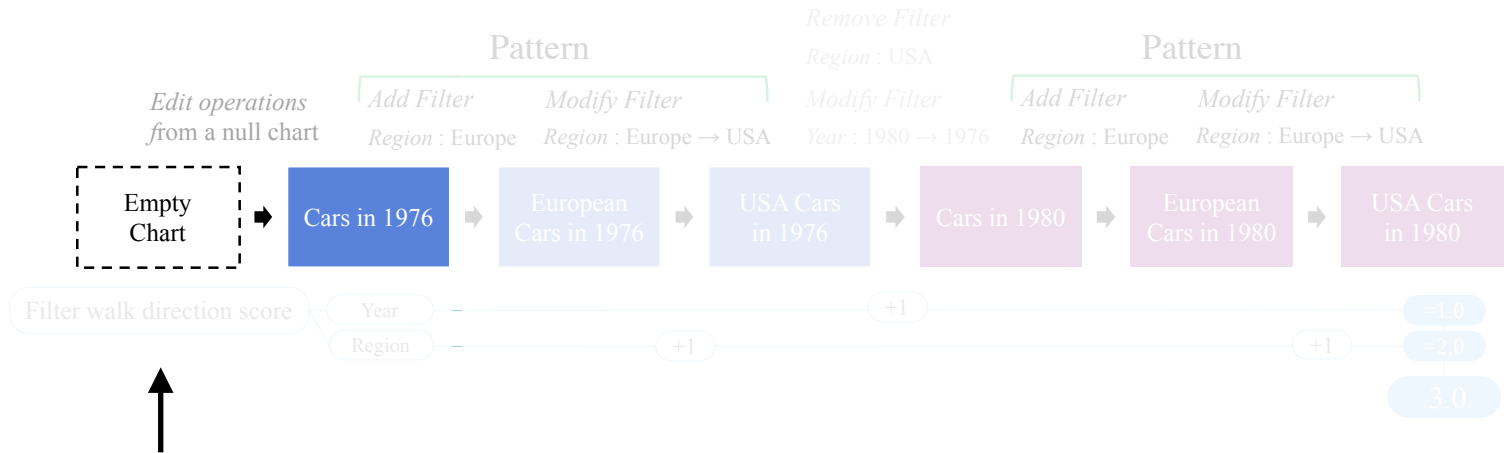
Sorted by  
Final Sequence Cost



Sorted by  
Sum of Transition Costs

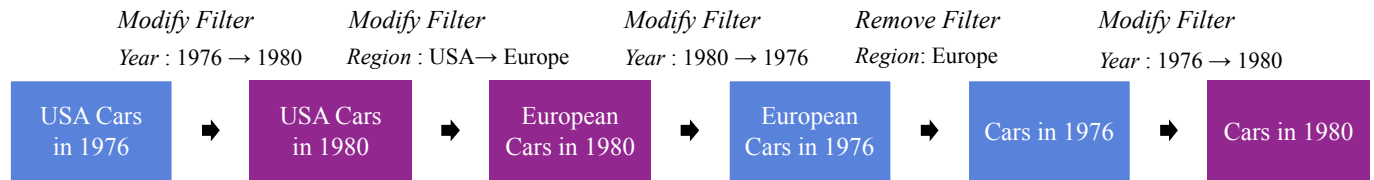


Sorted by  
Final Sequence Cost

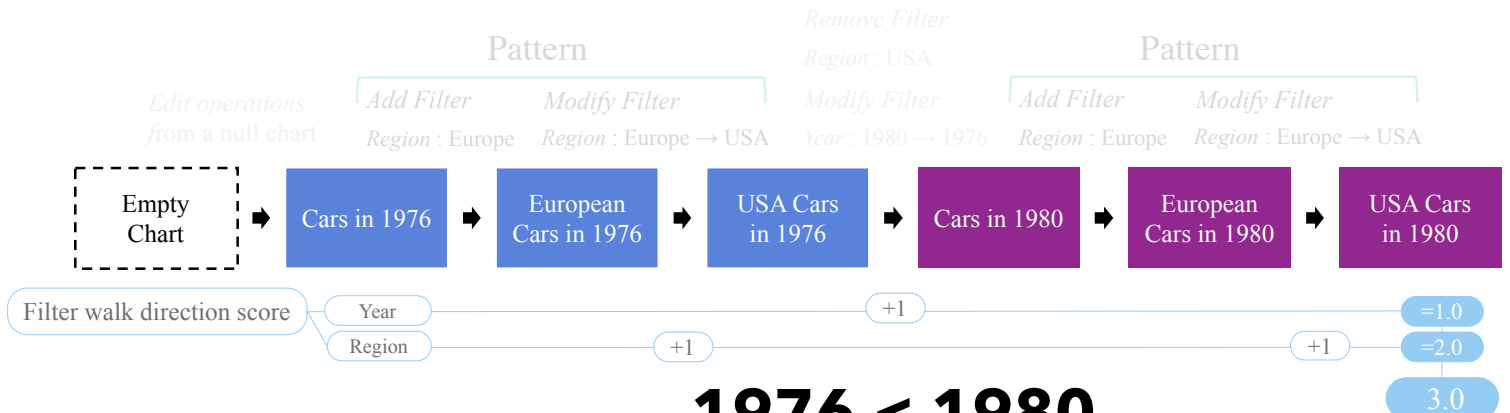


Begin with the empty (null) chart  
Account for interpretation of first chart

Sorted by  
Sum of Transition Costs

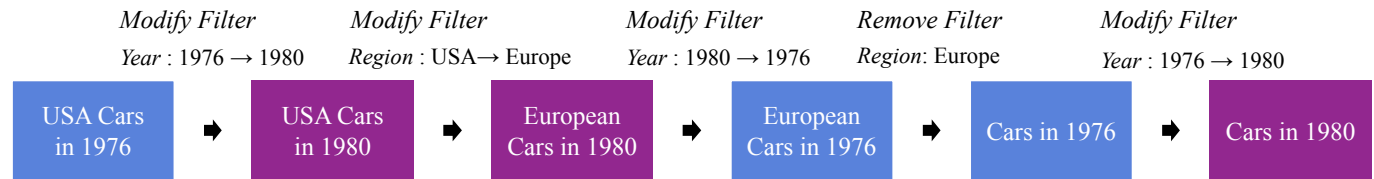


Sorted by  
Final Sequence Cost

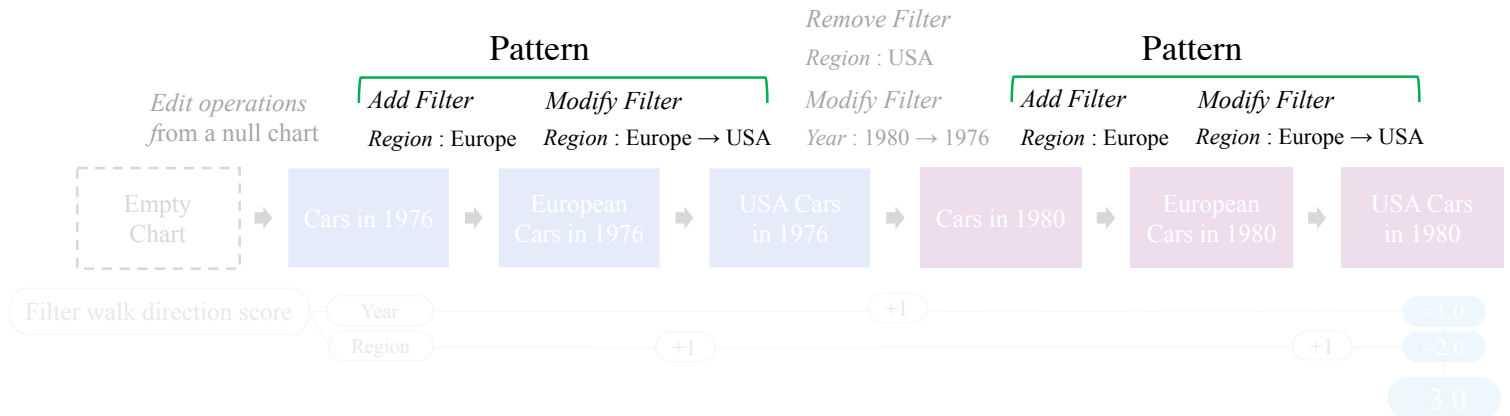


Prioritize sorted filter criteria  
Penalize unsorted orders

Sorted by  
Sum of Transition Costs



Sorted by  
Final Sequence Cost

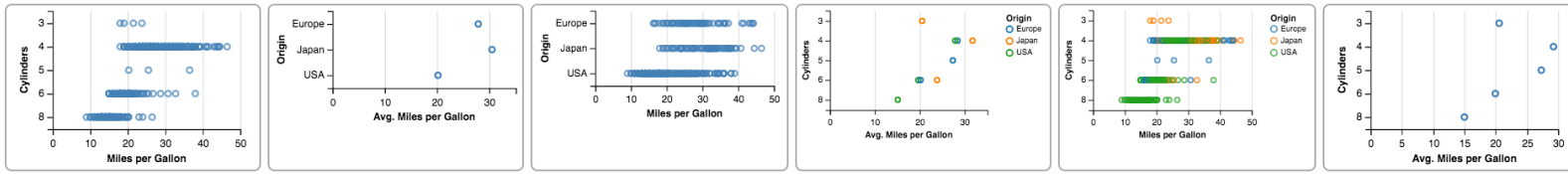


Find maximal repeating transition patterns  
 Determine fraction of transitions they cover  
 Weight overall score by this term



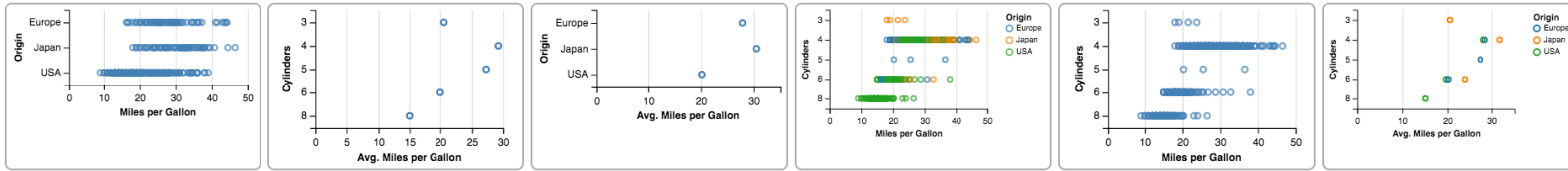


### Sequence 1



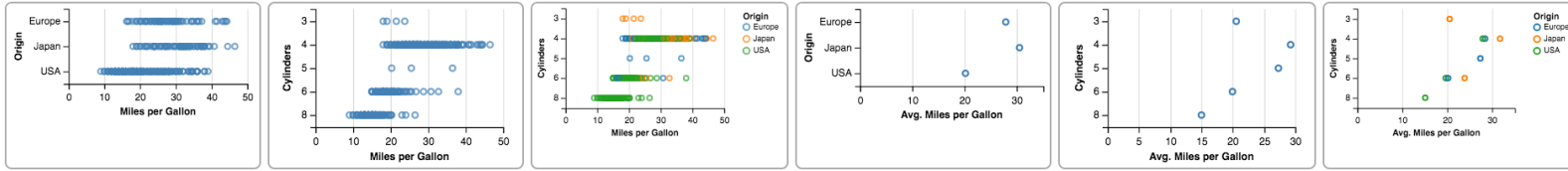
- Very Good
- Good
- Neutral
- Poor
- Very Poor

### Sequence 2



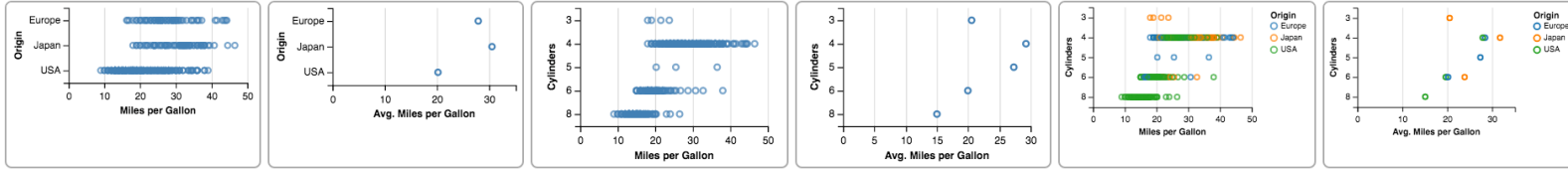
- Very Good
- Good
- Neutral
- Poor
- Very Poor

### Sequence 3



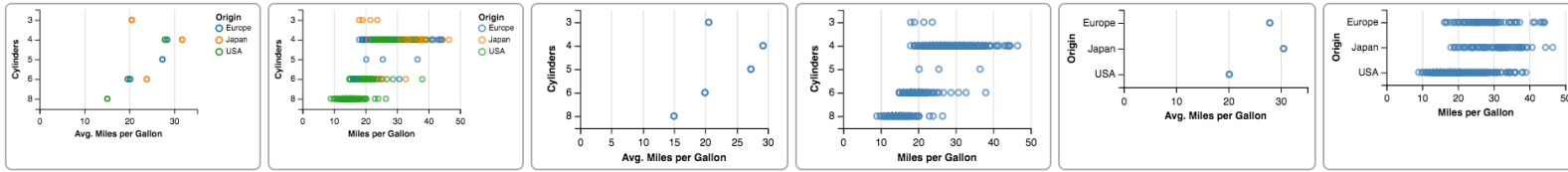
- Very Good
- Good
- Neutral
- Poor
- Very Poor

### Sequence 4



- Very Good
- Good
- Neutral
- Poor
- Very Poor

### Sequence 5



- Very Good
- Good
- Neutral
- Poor
- Very Poor

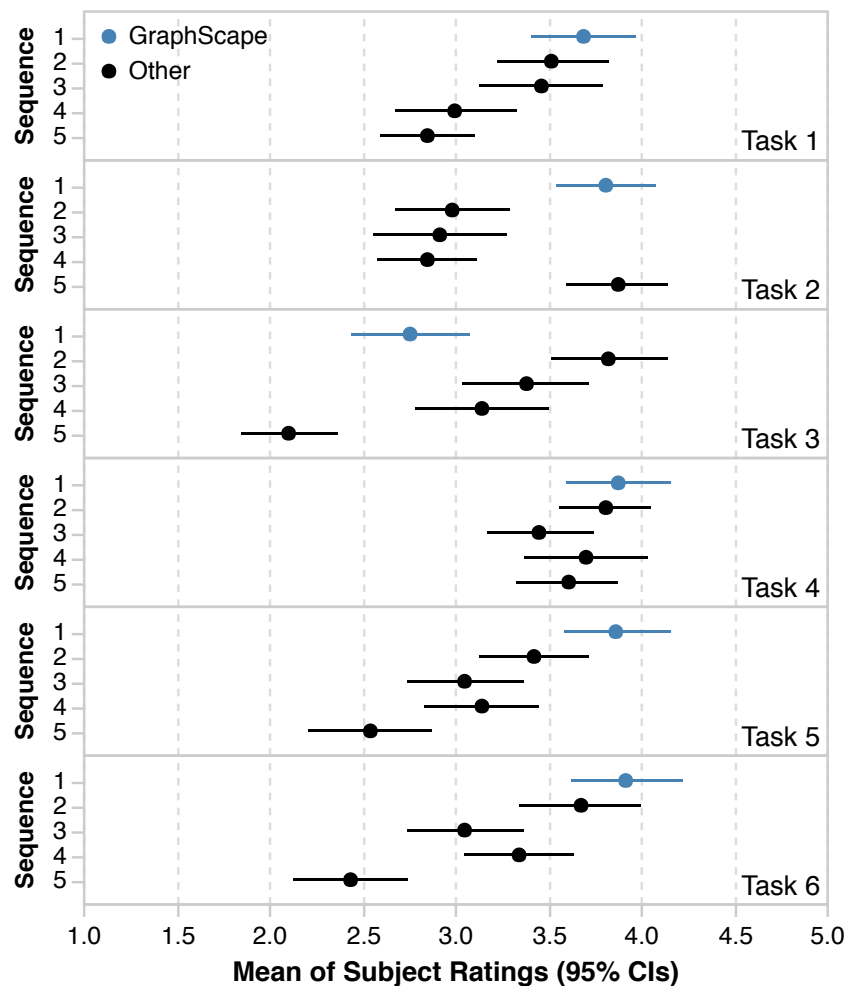
# Sequence Ratings

Evaluation with 55 subjects, recruited via Mechanical Turk.

Subjects rated quality and clarity on a 5-point Likert scale.

In all but one case, GraphScape's top pick among highest-rated.

GraphScape correlates strongly with subject rankings ( $\rho = 0.80$ ,  $p < 0.001$ ) when both transition & sequence terms are included.



# GraphScape

Previously we've discussed approaches for automatic design of a **single visualization**.

GraphScape supports automated design methods for **collections of visualizations**.

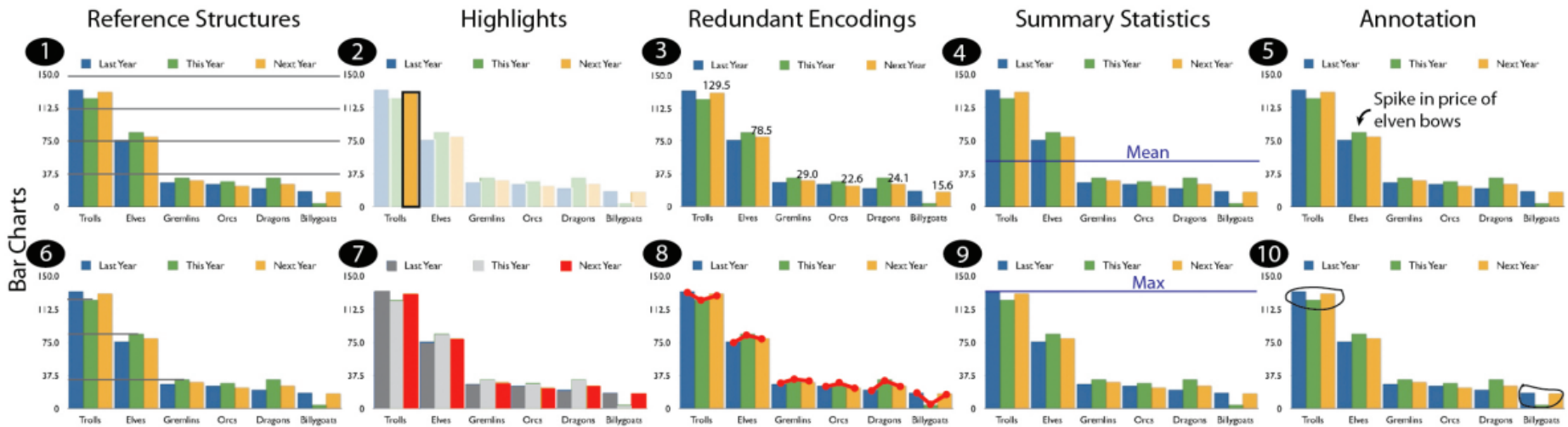
Plenty of future work to do here!

# Automatic Augmentation of Charts for Communication

**Given existing visualizations, can we adapt them to communicate more effectively?**

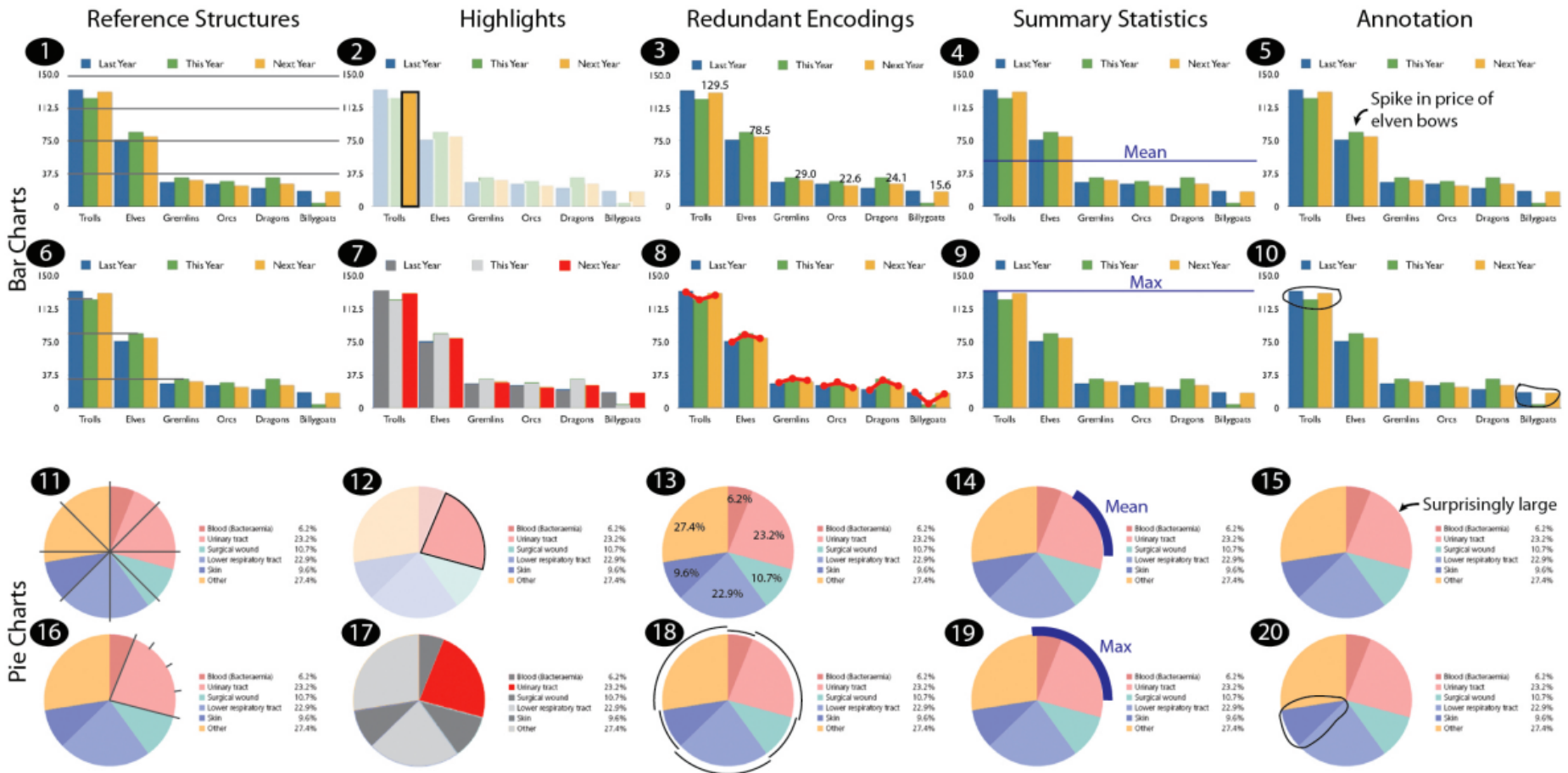
# Graphical Overlays [Kong et al. '12]

Add (interactive) reading aids to bitmap charts!



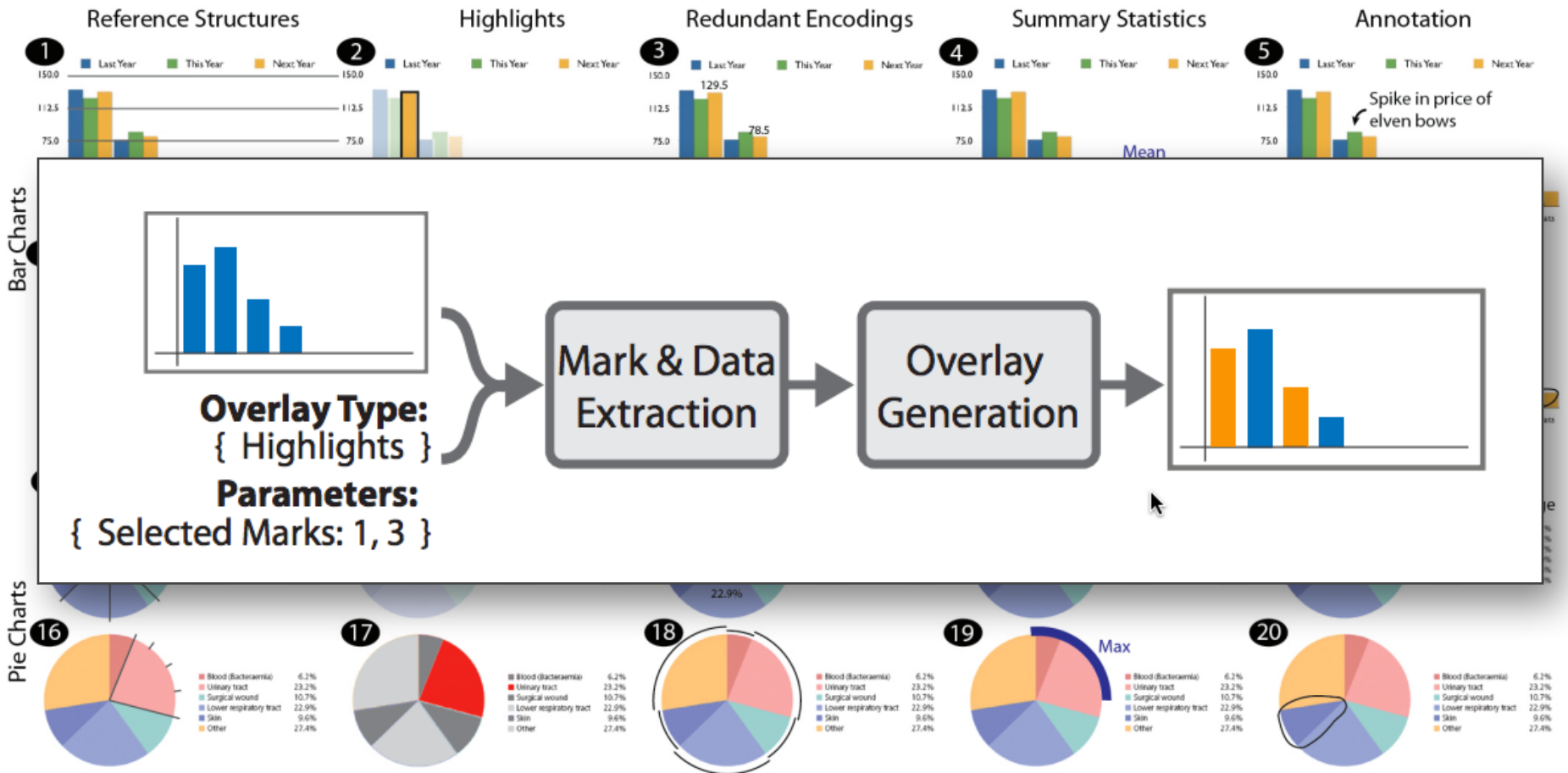
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Add (interactive) reading aids to bitmap charts!





# Annotated Visualizations in News

The New York Times

Business Day  
Technology

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Go

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Internet Start-Ups Business Computing Companies

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## Apple Passes Microsoft as No. 1 in Tech

By MIGUEL HELFT and ASHLEE VANCE  
Published: May 26, 2010

SAN FRANCISCO — Wall Street has called the end of an era and the beginning of the next one: The most important technology product no longer sits on your desk but rather fits in your hand.



Jim Wilson/The New York Times  
Apple fans crowded the iPad demo area at the company's downtown San Francisco store.

Multimedia



Interactive Feature  
Apple and Microsoft's Tug of War

Related

Times Topic: Apple Inc.

The moment came Wednesday when [Apple](#), the maker of iPods, iPhones and iPads, shot past [Microsoft](#), the computer software giant, to become the world's most valuable technology company.

This changing of the guard caps one of the most stunning turnarounds in business history for Apple, which had been given up for dead only a decade earlier, and its co-founder and visionary chief executive, [Steven P. Jobs](#). The rapidly rising value attached to Apple by investors also heralds an important cultural shift: Consumer tastes have overtaken the needs of business as the leading force shaping technology.

Microsoft, with its Windows and Office software franchises, has dominated the relationship most people had with their computers for almost two decades, and that was reflected in its stock market capitalization. But the click-clack of the keyboard has ceded ground to the swipe of a finger across a smartphone's touch screen.

- RECOMMEND
- TWITTER
- LINKEDIN
- COMMENTS (240)
- E-MAIL
- PRINT
- REPRINTS
- SHARE

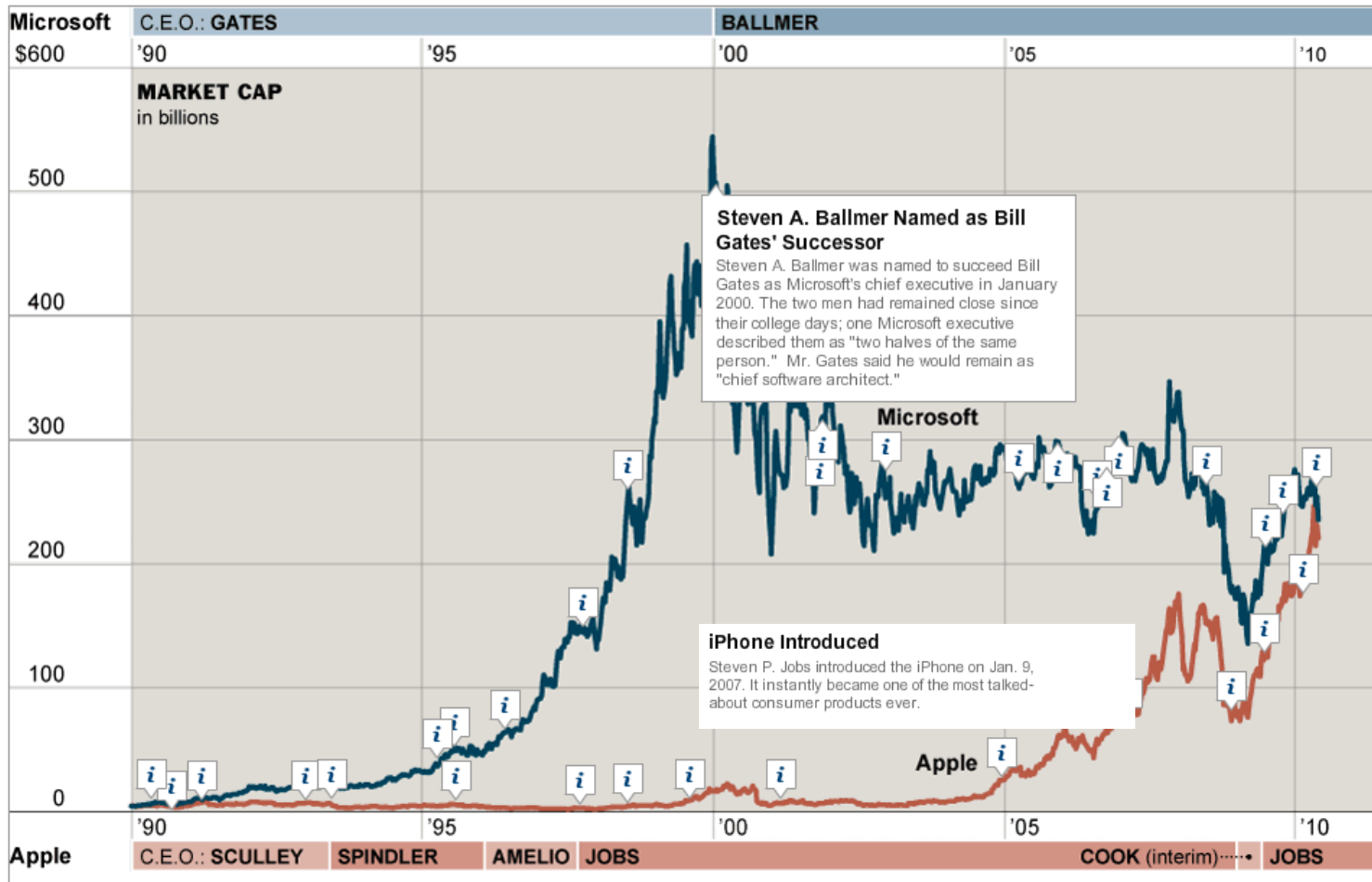


## Apple and Microsoft's Tug of War

Apple, the maker of iPods, iPhones and iPads, shot past Microsoft on May 26, 2010, supplanting the computer software giant as the world's most valuable technology company. This changing of the guard caps one of the most stunning turnarounds in business history for Apple, which had been given up for dead only a decade earlier. The rapidly rising value attached to Apple by investors also heralds an important cultural shift: Consumer tastes have overtaken the needs of business as the leading force shaping technology. [Related Article »](#)



# Annotations Tell a Story



Produced by Joshua Brustein and Danielle Belopotosky/The New York Times

Can we produce an automated solution?

# Contextifier System [Hullman et al.]

Input: news article about a company

TECHNOLOGY

## Yahoo Decides to Friend Facebook

By AMIR EFRATI  
Updated Feb. 15, 2011 12:01 a.m. ET

Yahoo Inc. +1.34% watched as social-networking website Facebook Inc. stole the attention of users and grabbed a major share of the online-advertising market.

Now the Internet pioneer is following an old mantra: If you can't beat 'em, join 'em.

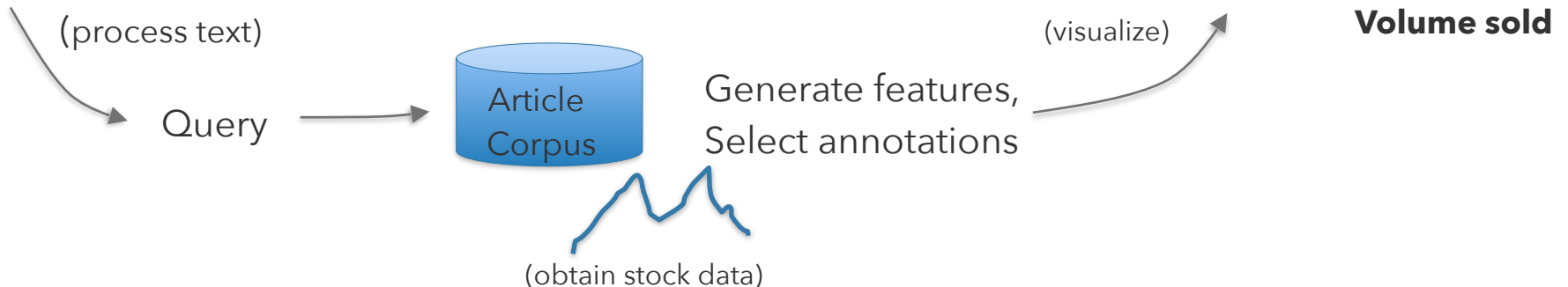


Enlarge Image

CEO Carol Bartz is trying to grab more traffic for Yahoo through the company's recent ties with Facebook. *Bloomberg News*

After struggling for years to develop services that compete with the social network, Yahoo in recent months has installed tools such as Facebook's "Like" and "Share" buttons on its news and sports websites in order to help Yahoo users share articles with their contacts on Facebook, among other things.

Yahoo, like other content providers, is seeking to leverage Facebook's huge user base to draw more traffic back to Yahoo after readers click on the sharing buttons. The moves also are aimed at ensuring that links to Yahoo content appear in the search feature on Facebook's site. Yahoo is using similar approaches with Twitter Inc., the Internet messaging service, and Zynga Game Network Inc., which offers online social games.



# Relevancy Feature

TECHNOLOGY

## Yahoo Decides to Friend Facebook

By AMIR EFRATI  
Updated Feb. 15, 2011 12:01 a.m. ET

Yahoo Inc. (YHOO +1.34%) watched as social-networking website Facebook Inc. stole the attention of users and grabbed a major share of the online-advertising market.

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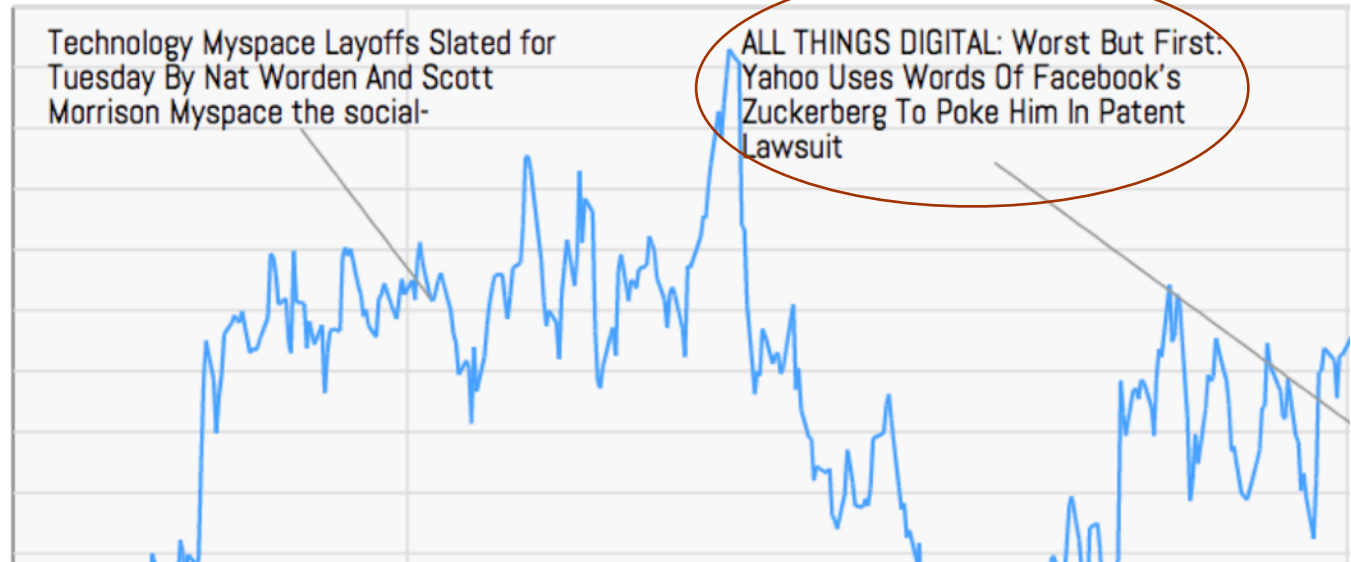


Enlarge Image

CEO Carol Bartz is trying to grab more traffic for Yahoo through the company's recent ties with Facebook. (Bloomberg News)

After struggling for years to develop services that compete with the social network, Yahoo in recent months has installed tools such as Facebook's "Like" and "Share" buttons on its news and sports websites in order to help Yahoo users share articles with their contacts on Facebook, among other things.

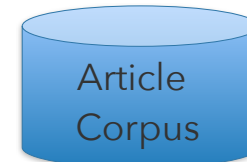
Yahoo, like other content providers, is seeking to leverage Facebook's huge user base to draw more traffic back to Yahoo after readers click on the sharing buttons. The moves also are aimed at ensuring that links to Yahoo content appear in the search feature on Facebook's site. Yahoo is using similar approaches with Twitter Inc., the Internet messaging service, and Zynga Game Network Inc., which offers online social games.



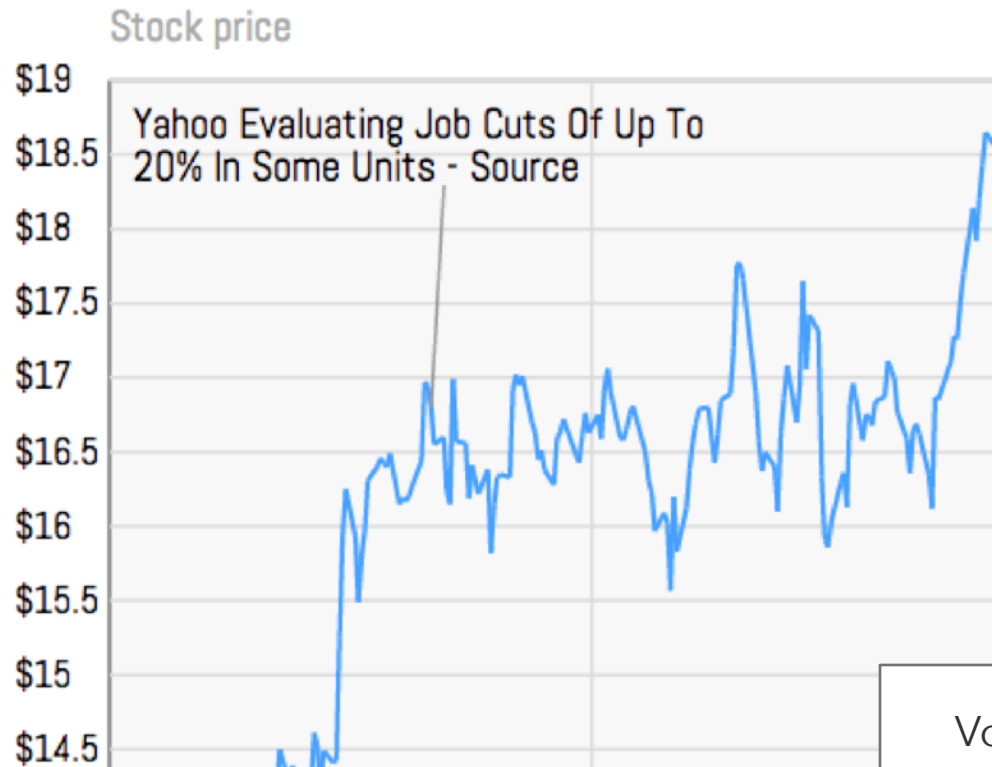
Do other articles that mention the company have relevant content?

Use Kullback-Leibler divergence to measure difference.

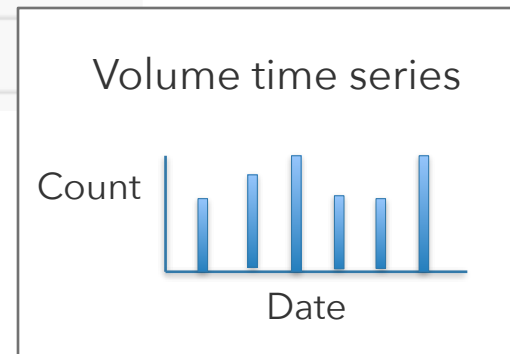
$$D_{KL}(P \parallel Q) = \sum_i P(i) \log \frac{P(i)}{Q(i)}$$



# Article Volume



Prioritize dates with unusually high numbers of company articles.



# Visual Saliency

TECHNOLOGY

## Yahoo Decides to Friend Facebook

By AMIR EFRATI  
Updated Feb. 15, 2011 12:01 a.m. ET

Yahoo Inc. (YHOO +1.34%) watched as social-networking website Facebook Inc. stole the attention of users and grabbed a major share of the online-advertising market.

Now the Internet pioneer is following an old mantra: If you can't beat 'em, join 'em.

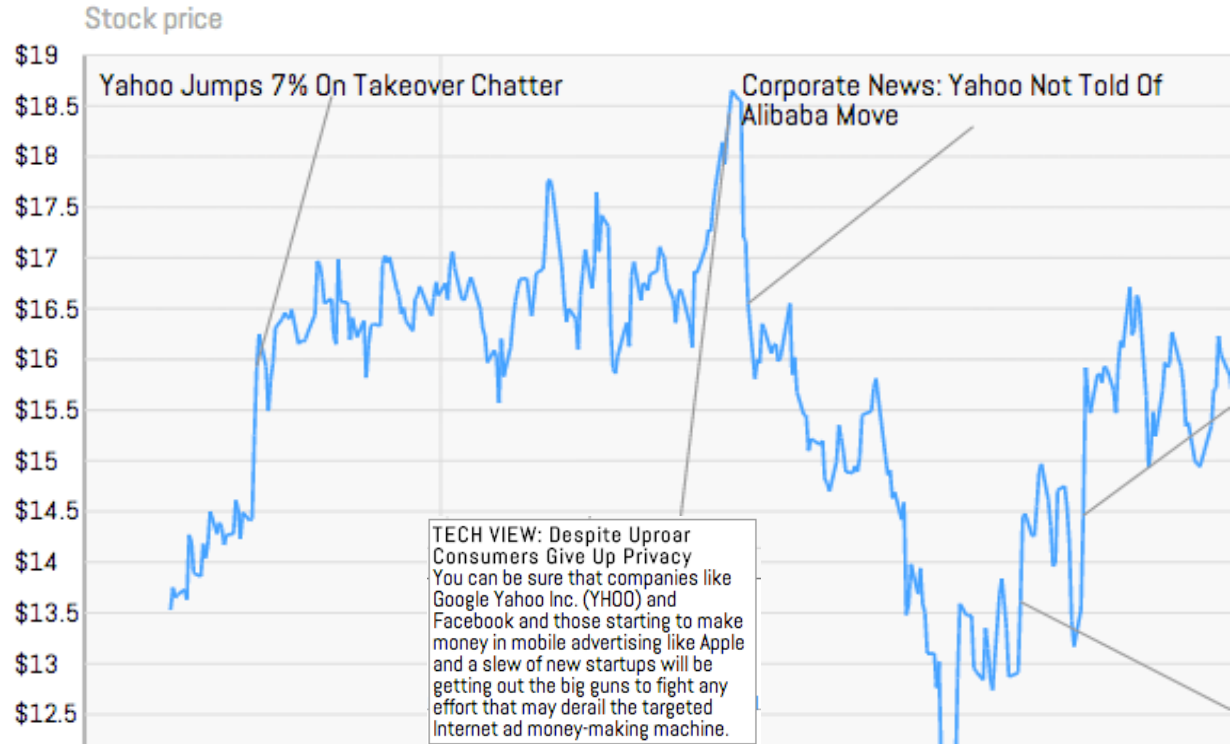


Enlarge Image

CEO Carol Bartz is trying to grab more traffic for Yahoo through the company's recent ties with Facebook. *Bloomberg News*

After struggling for years to develop services that compete with the social network, Yahoo in recent months has installed tools such as Facebook's "Like" and "Share" buttons on its news and sports websites in order to help Yahoo users share articles with their contacts on Facebook, among other things.

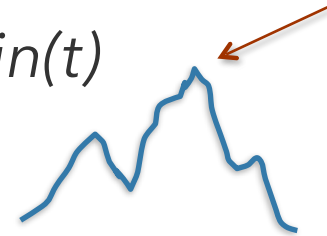
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Visual saliency proxy via simple analyses on stock series.

$$\max(t), \min(t)$$

$$t_i - t_{i-1}$$



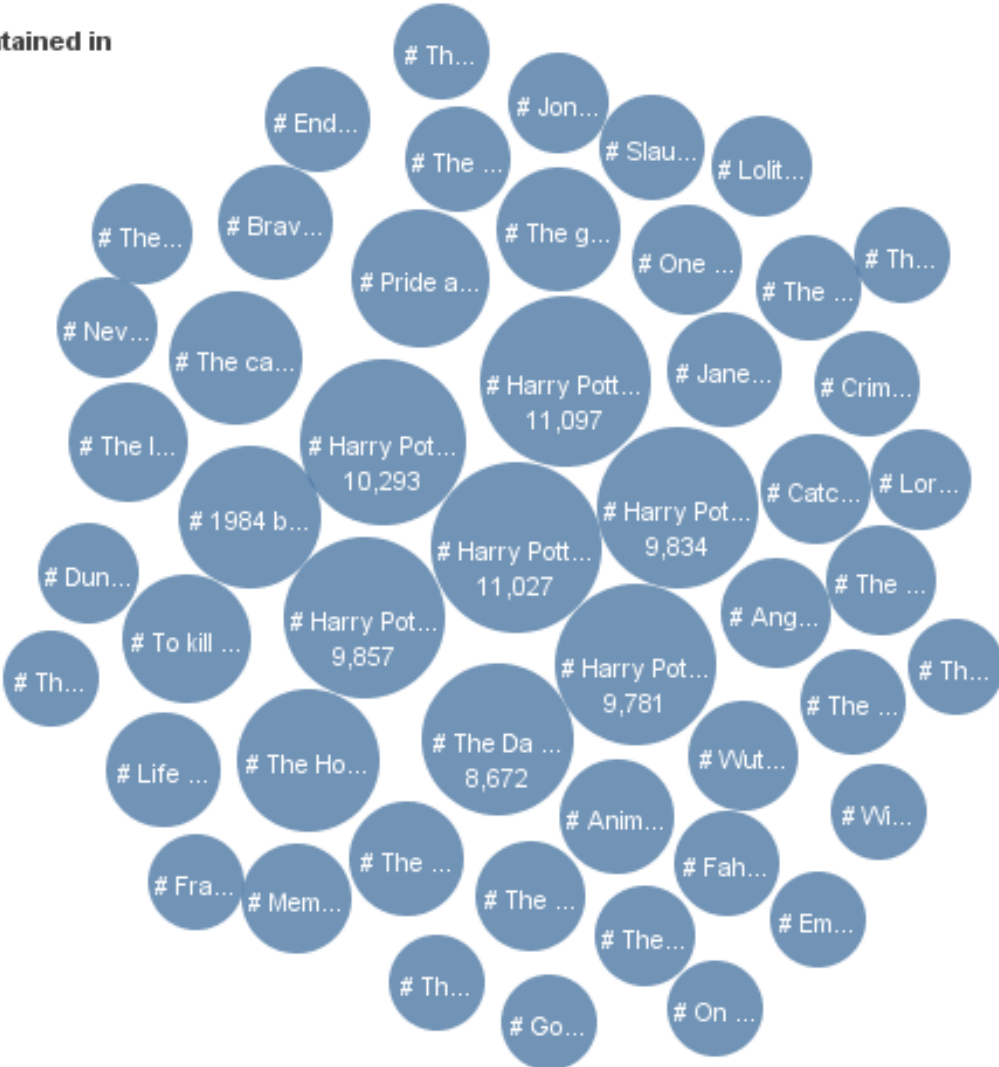
# Public Visualization as Survey Instrument

# Visualizations : Harry Potter is Freaking Popular

Creator: Alison

Tags:

Number of Libraries Contained in

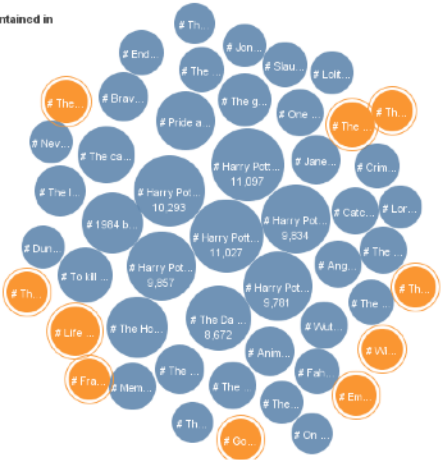


To highlight or find totals  
click or ctrl-click.

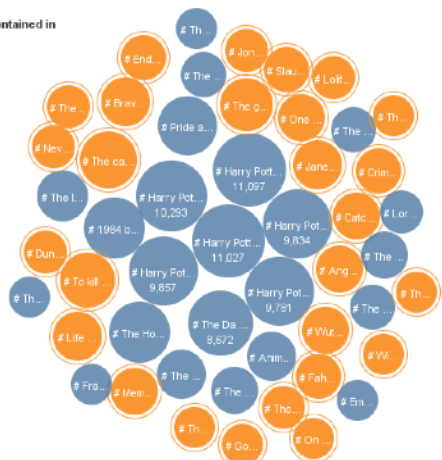
Color



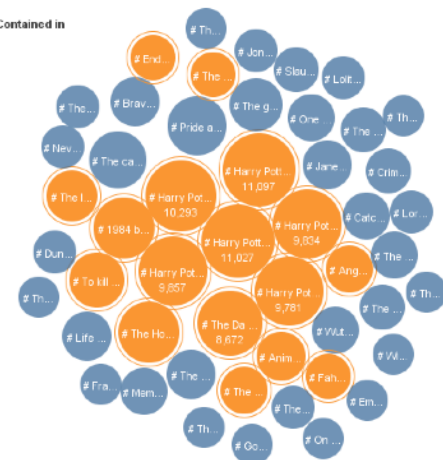
Number of Libraries Contained in



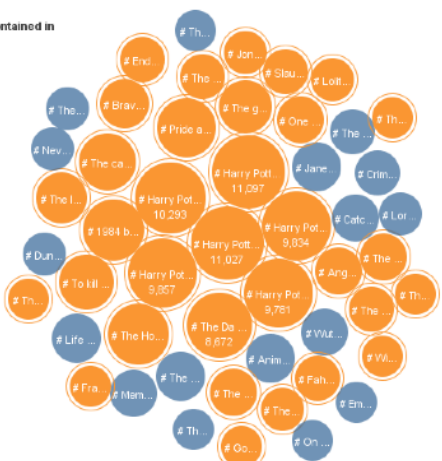
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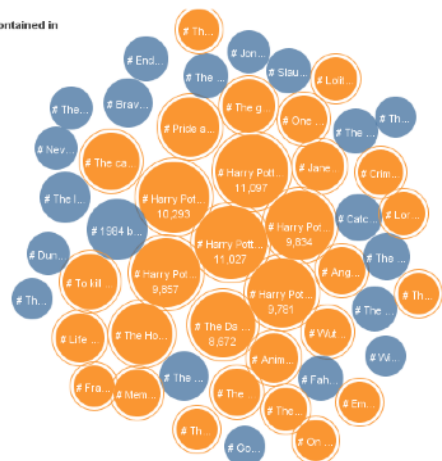
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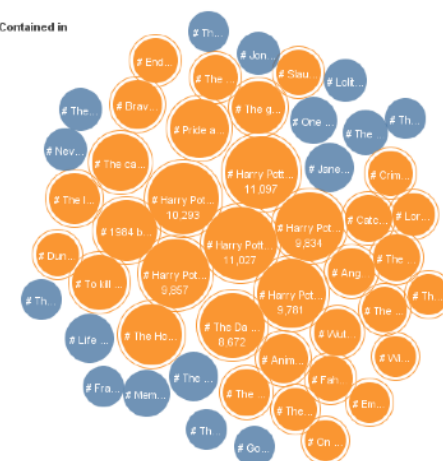
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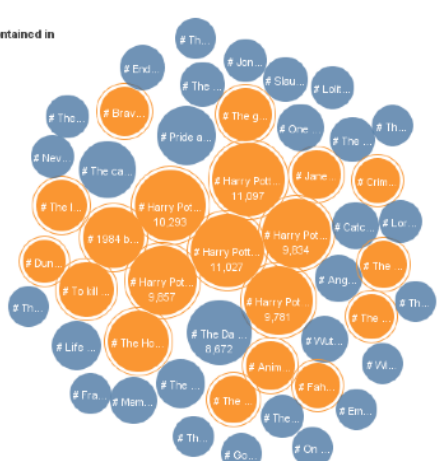
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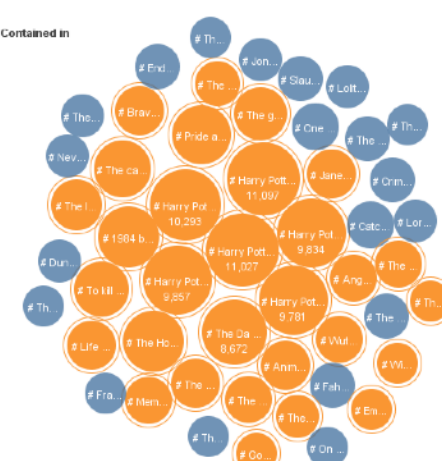
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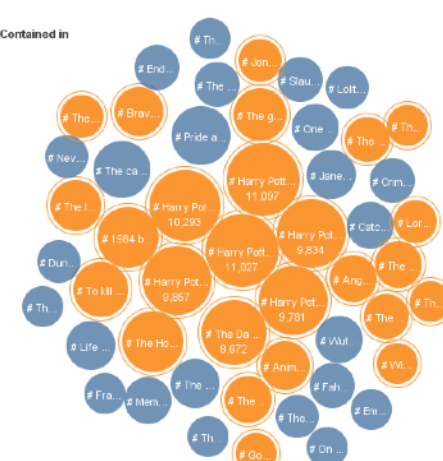
Number of Libraries Contained in



Number of Libraries Contained in



Number of Libraries Contained in



Colors show if people think that:

income inequality has contributed to the country's problems.

Disagree  Agree

### Do you agree or disagree with the main goals of the Occupy Wall Street movement?

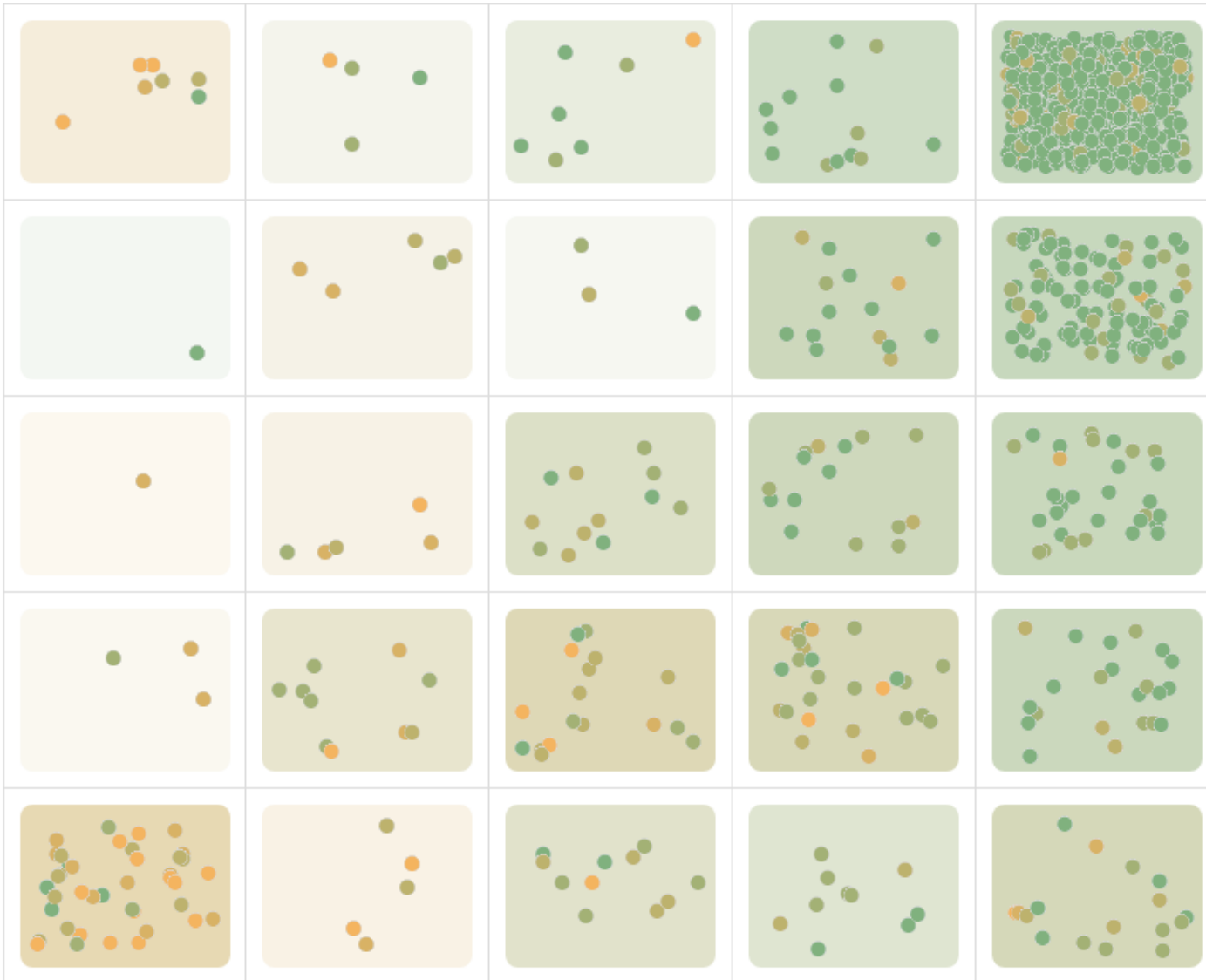
Strongly Disagree

Disagree

Neutral

Agree

Strongly Agree



Strongly Support

Support

Neutral

Oppose

Strongly Oppose

Do you support or oppose the methods of the protesters?

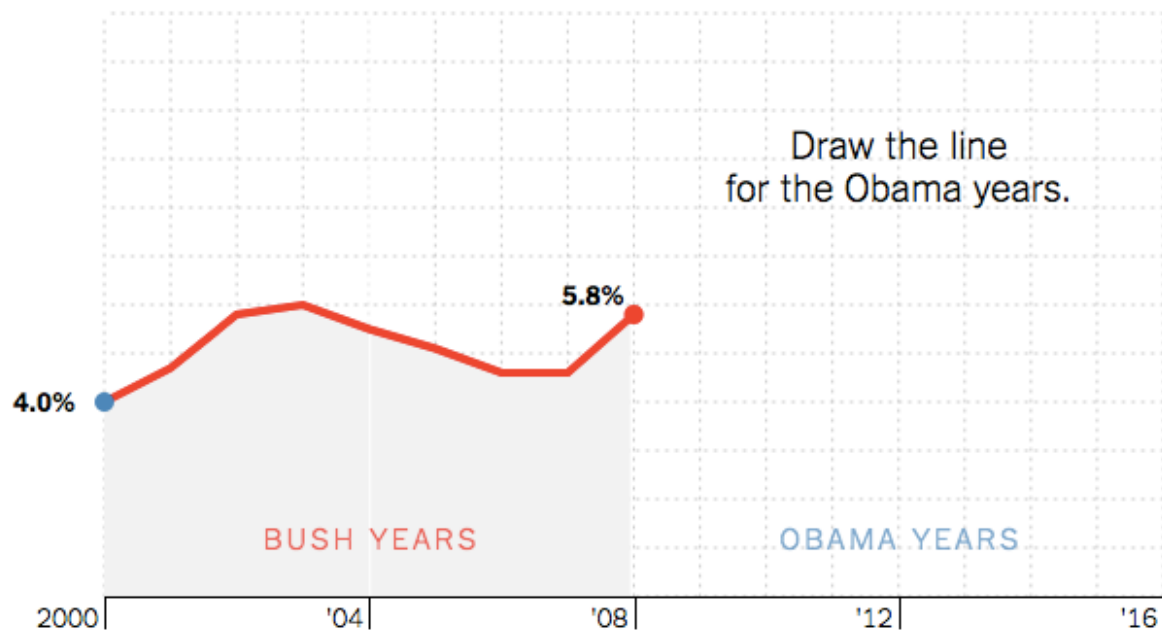


# You Draw It: What Got Better or Worse During Obama's Presidency

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** ...



Show me how I did.