CS 171

# Evaluation & Innovation

Hanspeter Pfister / Hendrik Strobelt

I now know more about the four different visualization methods (text, maps, networks, high-dimensional visualization) and know at least 3 different visualization types for each of them.

| | | |
|---|---|---|
| **Strongly disagree** | 4 respondents | **5 %** |
| Slightly disagree | 3 respondents | 4 % |
| Slightly agree | 30 respondents | 38 % |
| Strongly agree | 41 respondents | 53 % |

Attempts: 78 out of 78

The poster session has given me new ideas for the final project.

| | | |
|---|---|---|
| **Strongly disagree** | 7 respondents | **9 %** |
| Slightly disagree | 15 respondents | 19 % |
| Slightly agree | 39 respondents | 50 % |
| Strongly agree | 17 respondents | 22 % |

Attempts: 78 out of 78

I feel comfortable working in my team, and feel that we created a successful poster.

| | | |
|---|---|---|
| **Strongly disagree** | 3 respondents | **4 %** |
| Slightly disagree | | 0 % |
| Slightly agree | 23 respondents | 29 % |
| Strongly agree | 52 respondents | 67 % |

# Feedback

- Poster session was fun and design challenge of making a poster was good. Appreciated the chance to work on something with the team

- Exercise was not effective method of learning about the 4 topics.

- Limited opportunity to exchange ideas on the topics, and none of it from an authoritative source.

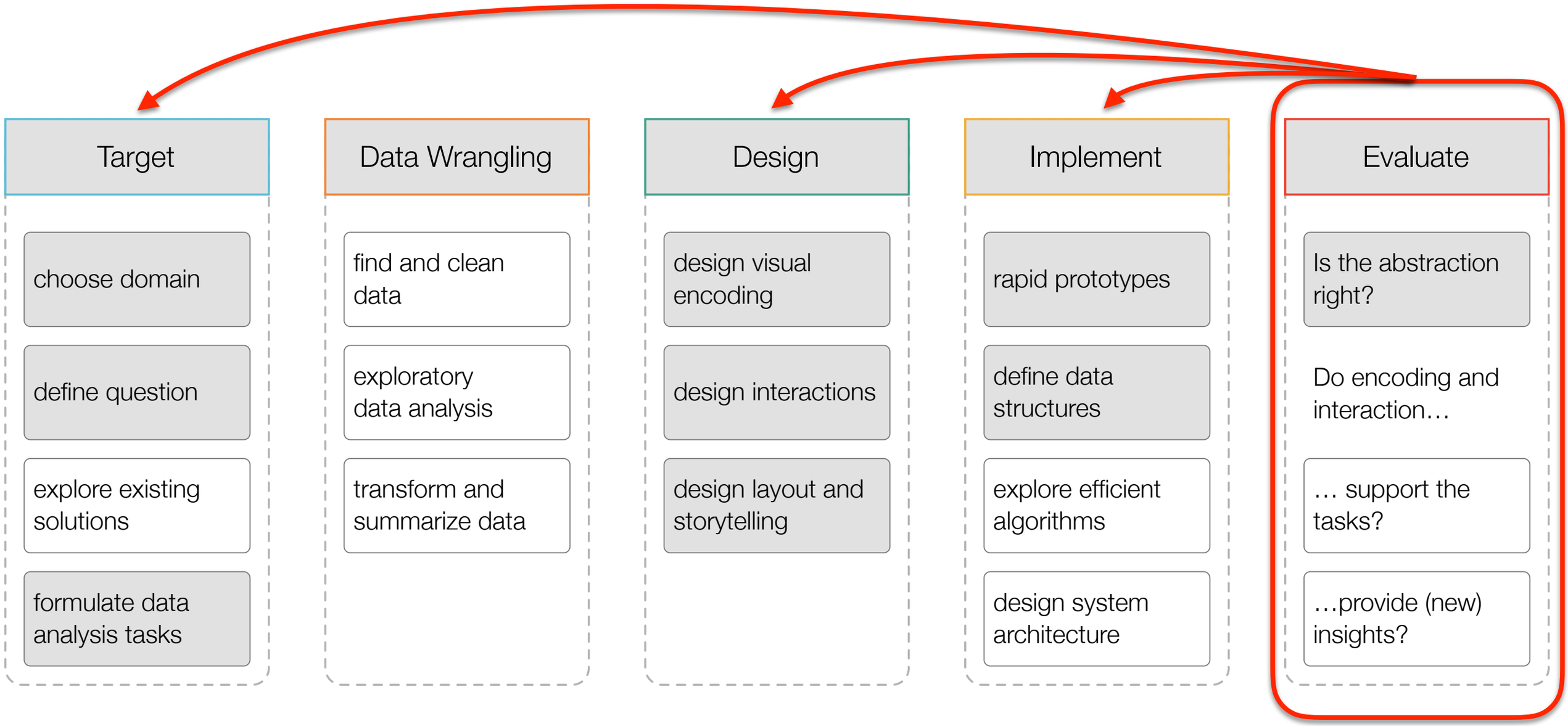
# Today

- Get an **Overview** of the Evaluation Process

- Ideas for **Innovation** in visualization

- How to **Innovate** using D3

# Evaluation


Target
choose domain
define question
explore existing solutions
formulate data analysis tasks
Data Wrangling
find and clean data
exploratory data analysis
transform and summarize data
Design
design visual encoding
design interactions
design layout and storytelling
Implement
rapid prototypes
define data structures
explore efficient algorithms
design system architecture
Evaluate
Is the abstraction right?
Do encoding and interaction…
… support the tasks?
…provide (new) insights?

# Validation vs. Evaluation

- **Validation**: the process of checking whether or not a design is appropriate for its purpose, meets all constraints, and will perform as expected. (“Are we building the right thing?”)
- **Evaluation**: the process of gathering information about some key characteristics of a certain design. (“Are we building the thing right?”)

# Activity

Think about how you will do the evaluations in your group projects.

(3 min)

# Evaluation Methods

- **Qualitative**
  - Exploratory
  - Non-statistical
- **Quantitative**
  - Structured, based on specific hypotheses
  - Statistical analysis

# Qualitative Studies

- Observational Studies (“Think Aloud”)
- Expert Interviews (aka Design Critiques)
- Focus Groups

# Activity

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Think Aloud study demo.

Where is the best place to send your child to school in New York City?

Aasta Frascati-Robinson, CS171

http://itisaasta.com/nycs/nycs.html

# Think Aloud Studies

- Naive (first time) users
- No explanations and interference by evaluator
  - “We are testing the system, not you.”
  - “Will not answer any questions once started.”
- Remind subjects to talk about what they are doing
- Do not reveal structure of the task
- Do not use vocabulary of the interface / tool

# Activity

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Form teams of two. How can you make Harvard #1 in the following interactive ranking visualization? (5 min)

Student 1: Use the system and explain what you are doing. (Think Aloud)

Student 2: Take notes (protocol)

http://bit.ly/cs171lineup

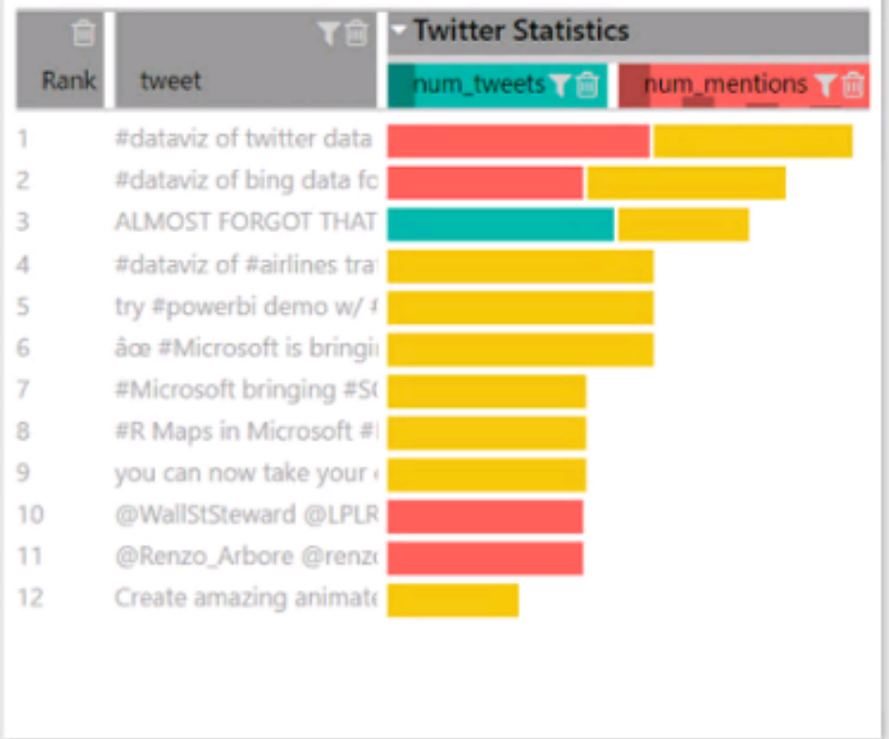
Power BI

Browse gallery How to use How to submit Docs

# custom visuals

A gallery of visuals created by the Power BI community. Browse through the visuals or submit one of your own for others to use.

Learn how to use custom visuals




## Table Sorter

*Published by Microsoft (experimental)*

This visual is currently in beta testing and is undergoing active development. Table Sorter lets you create stacked table columns to explore how different combinations and weightings of numerical column values result in different rank orderings of table records. Column headings show the distribution of column values and support rapid re-sorting of table rows (which may also be filtered by linked visuals). Table Sorter is built on LineUp (http://caleydo.github.io/tools/lineup/).

License Privacy Statement

Download Visual

*Version* **0.9.6** — *Date added* **3/21/2016**

Contact Author Support

SandDanc

Attribute Slicer

Gantt

Stars

Image Viewer

Long Text Viewer

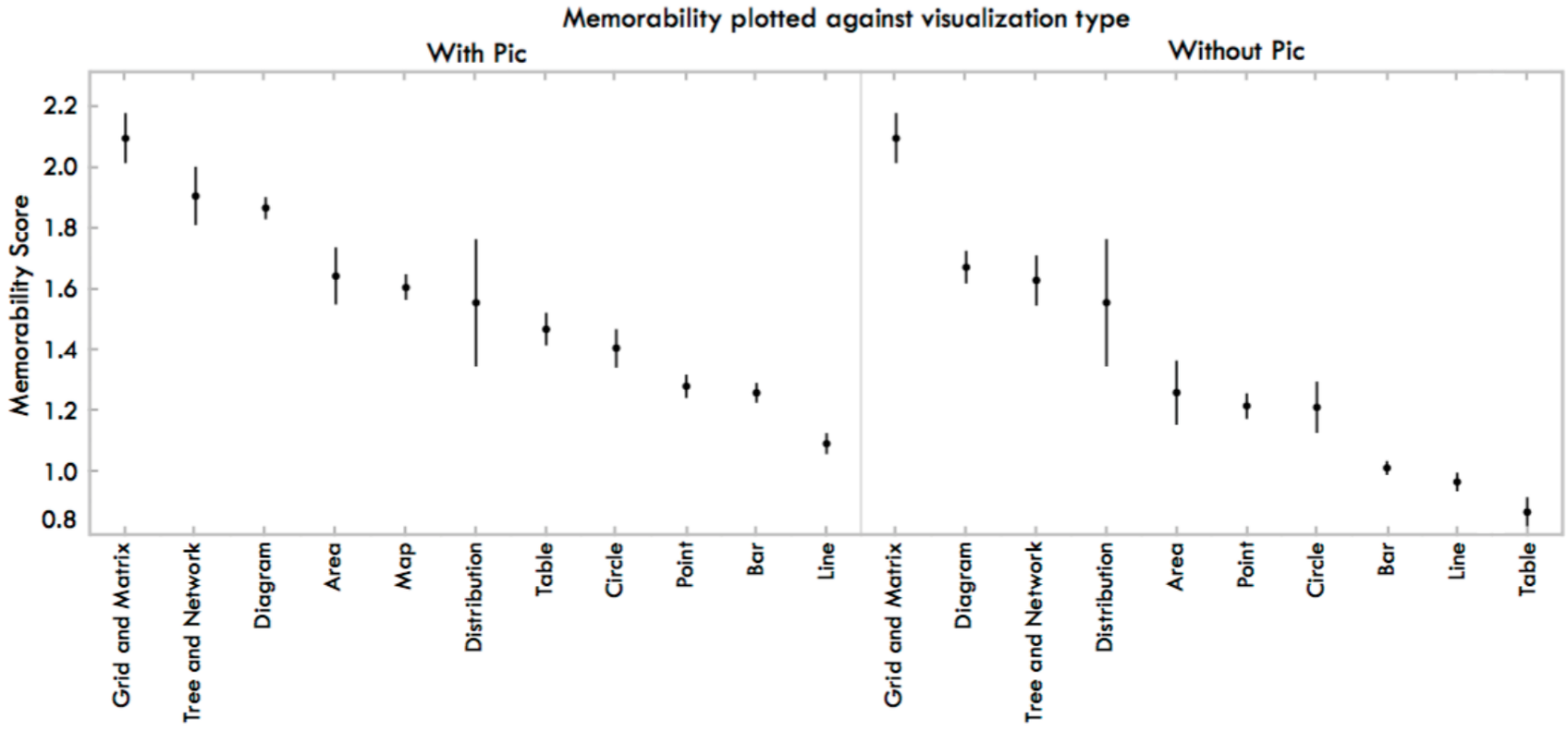
Microsoft Power BI transforms your company's data into rich visuals for you

# Expert Interviews

- Experts in visualization (i.e., you)
- Conversation with the designers
- Designers go through different goals and tasks
- Experts comment on visual encodings, interaction designs, usability, etc.
- Use expert terminology (Tufte's principles, channel encodings, perceptual issues, etc.)
- During studios this week

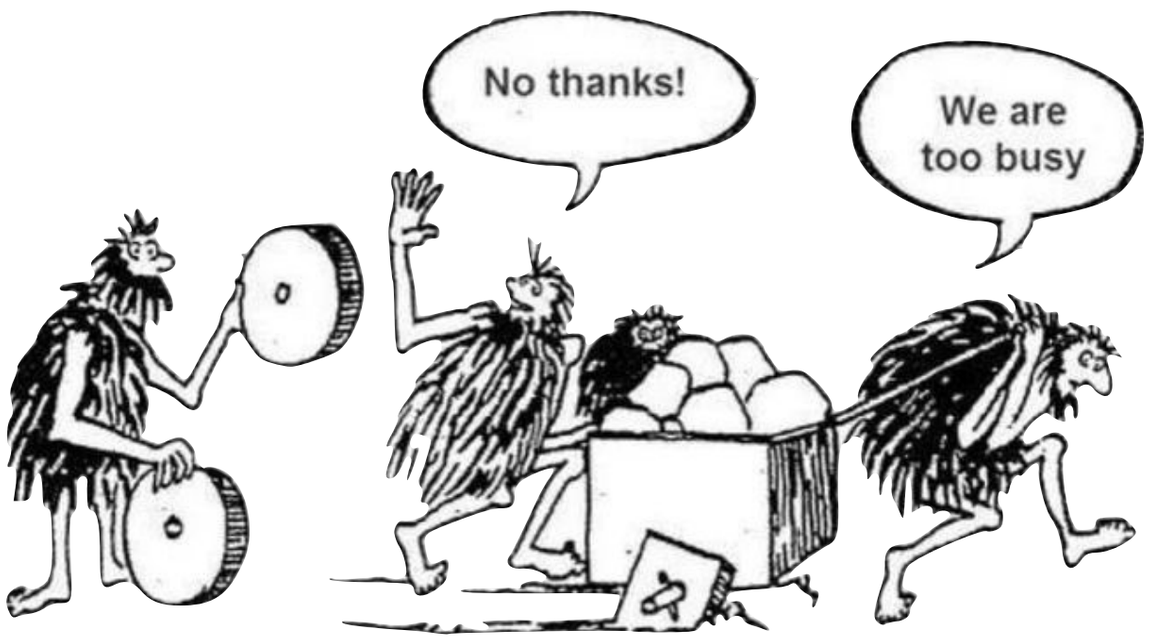
# Quantitative Studies

- Surveys/Questionnaires
- A/B Tests
- Crowdsourced Testing




M. A. Borkin, et al., “What Makes a Visualization Memorable?,” IEEE Transactions on Visualization and Computer Graphics (Proceedings of InfoVis 2013), 2013.

# Innovation

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# Your Projects

- Implement multiple coordinated (linked) views
- New this year: Implement at least one innovative view that is either
    - a) an extension of an existing visualization type, or
    - b) a novel visualization type

For grading the implementation part of the final project, we will evaluate projects by the following criteria:

- Effective visualizations
- Innovative visualizations
- Level of technical difficulty
- Clear storytelling
- Visual design (including website)
- Addresses the goals
- Sensible and effective interaction

http://www.cs171.org/2016/project/

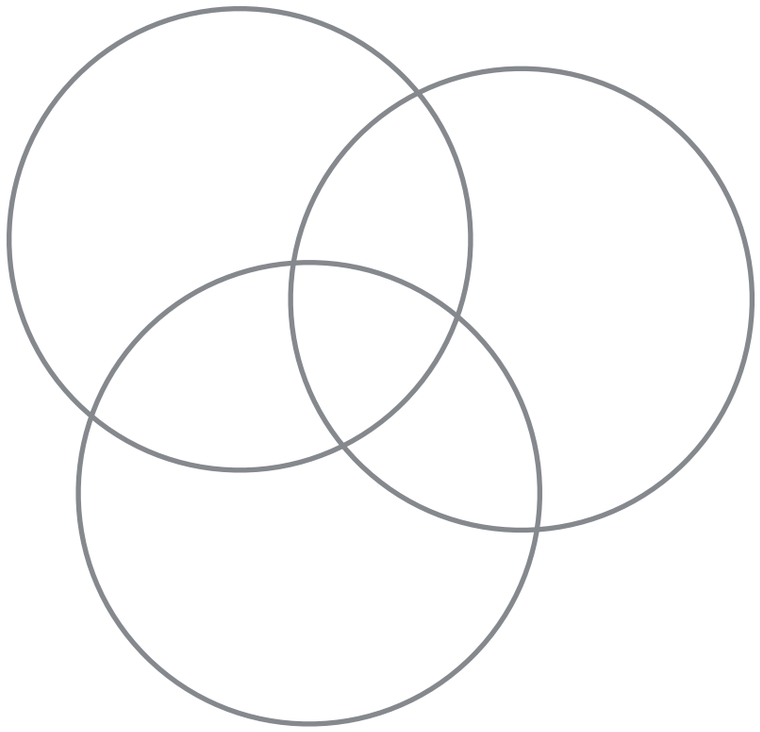
# Why?

- increase interestingness
- make your Vis unique and memorable
- increase empathy for your topic

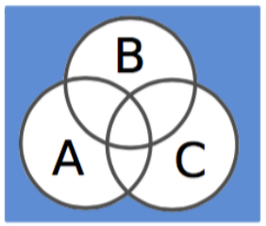
# How?

- Rethink your data
- Rethink encodings
- add storytelling elements
- **Do not limit effectiveness.**

# Rethink Your Data



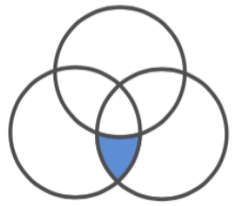
Set approach



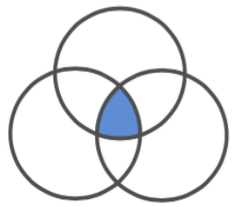

$\neg A \neg B \neg C$



$B \neg C \neg A$



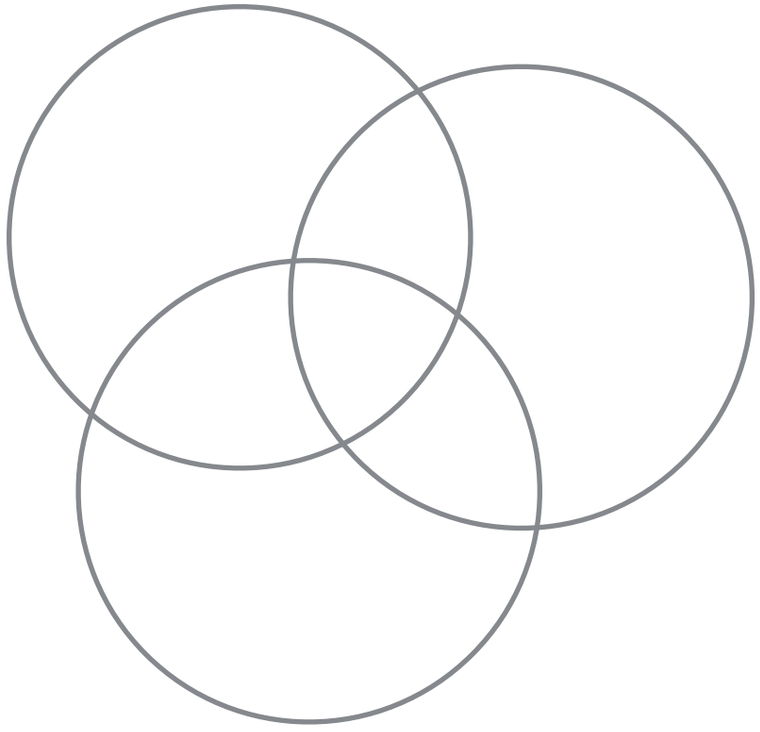
$(A \wedge C) \neg B$



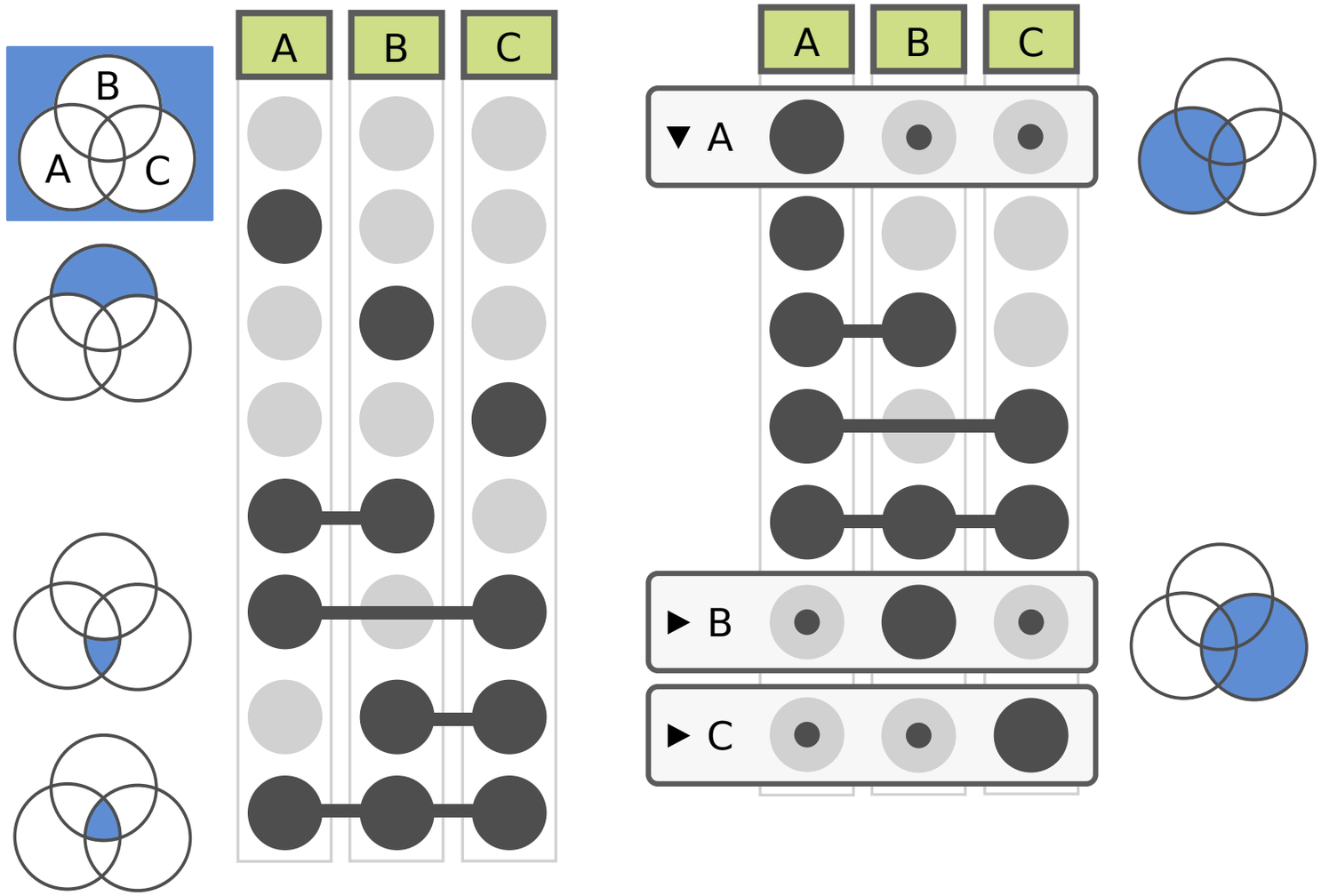
$(A \wedge B \wedge C)$

Combinatorial approach

# Rethink Your Encodings

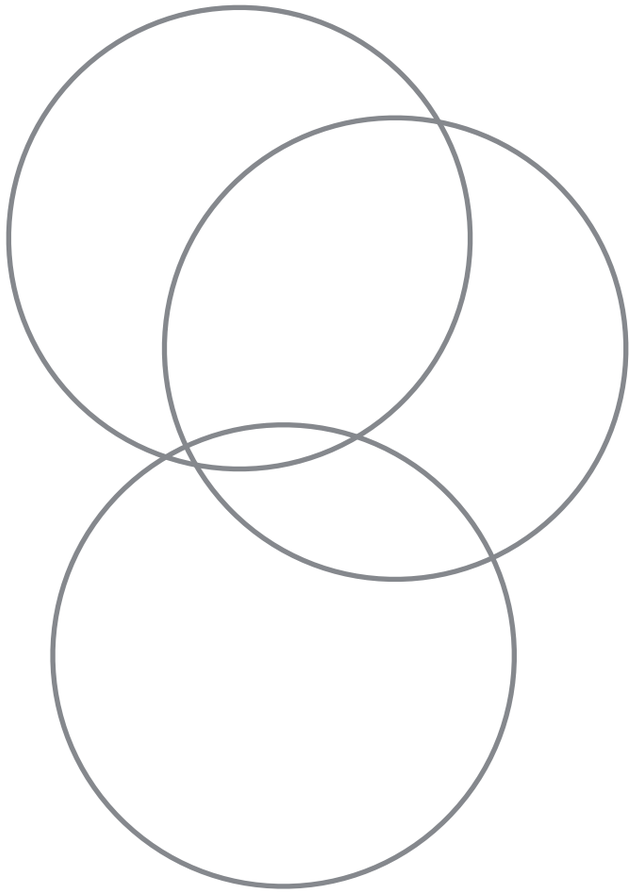


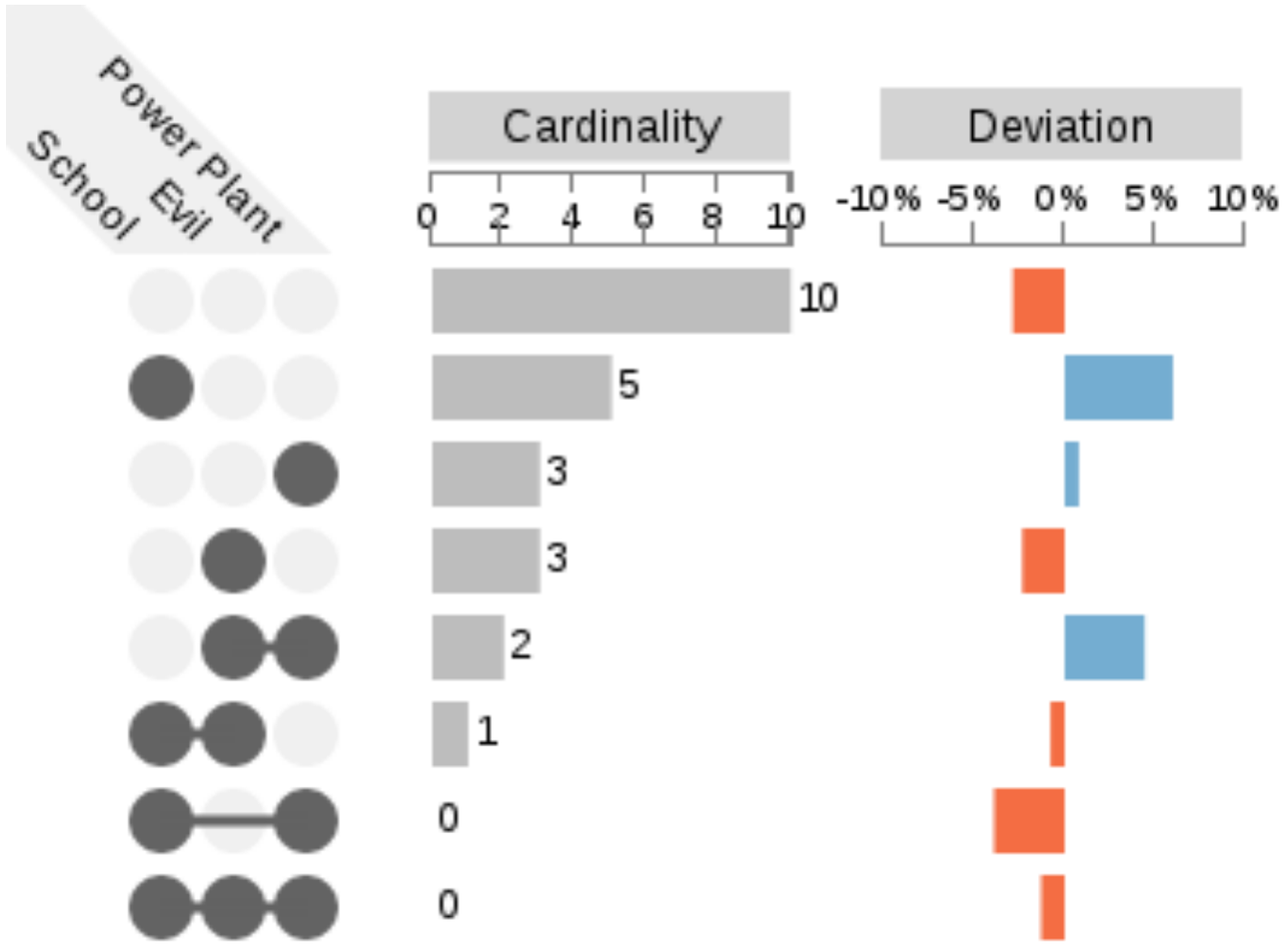
Set approach




Combinatorial approach

# Rethink Your Encodings





# Rethink Encodings

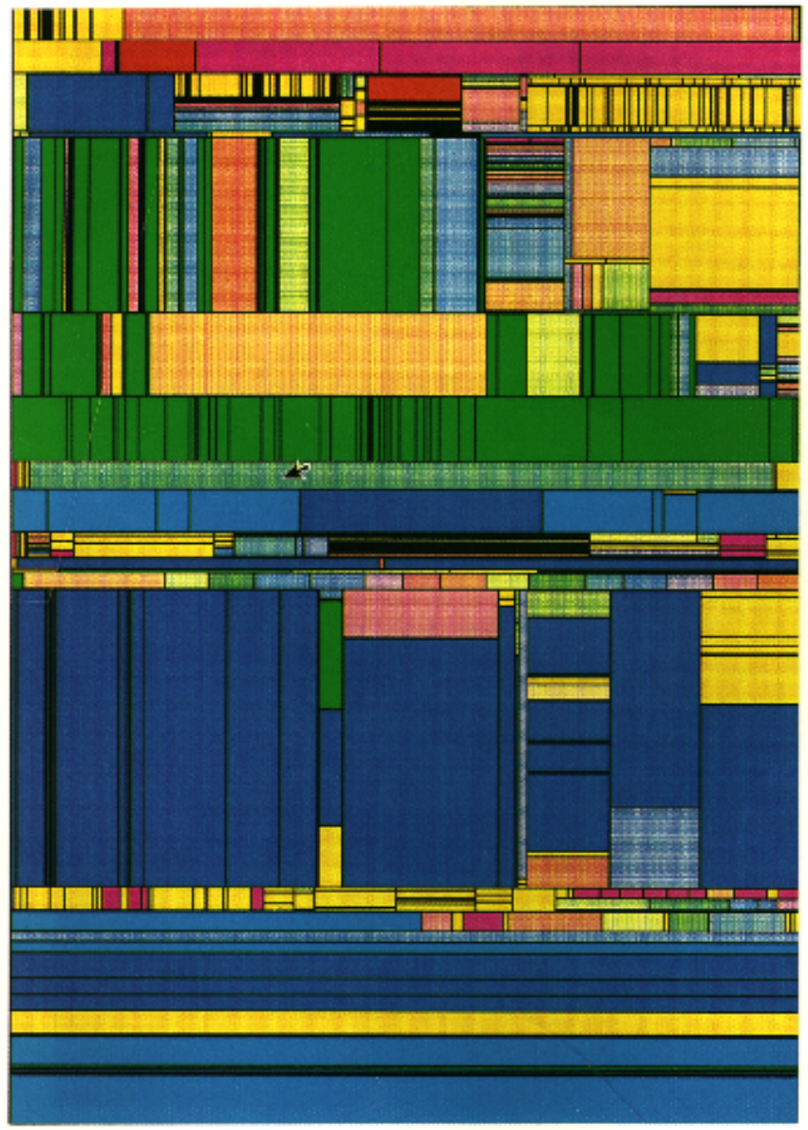
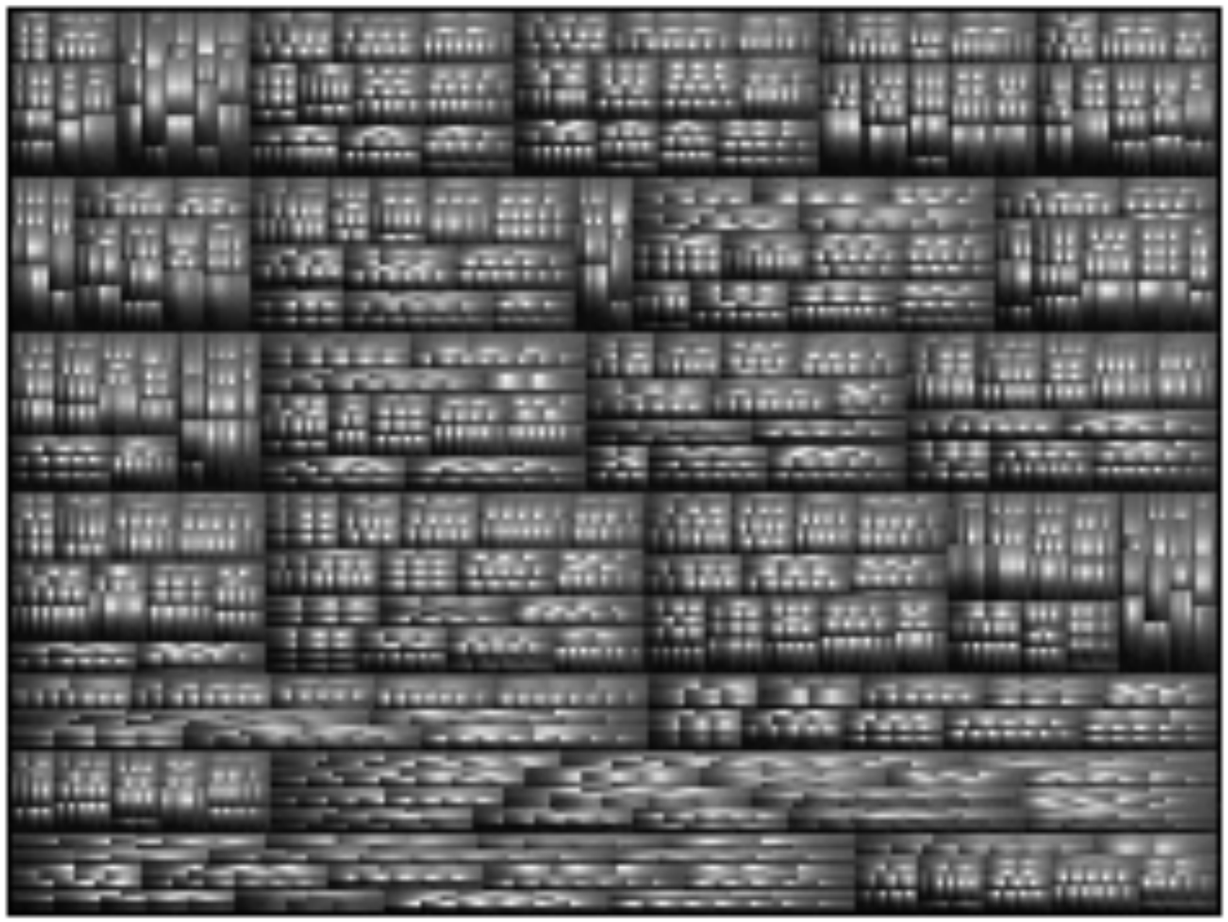


Fig. 4. 850 files at four levels with color coding by tile type. File name pops up when cursor rests on a file.

Treemap

Ben Shneiderman. 1992. Tree visualization with tree-maps: 2-d space-filling approach.
ACM Trans. Graph. 11, 1 (January 1992), 92-99



Cushion Treemap

Jarke J. Van Wijk and Huub van de Wetering. 1999. Cushion Treemaps: Visualization of Hierarchical Information. In Proceedings of the 1999 IEEE Symposium on Information Visualization (INFOVIS '99)

# Rethink Encodings

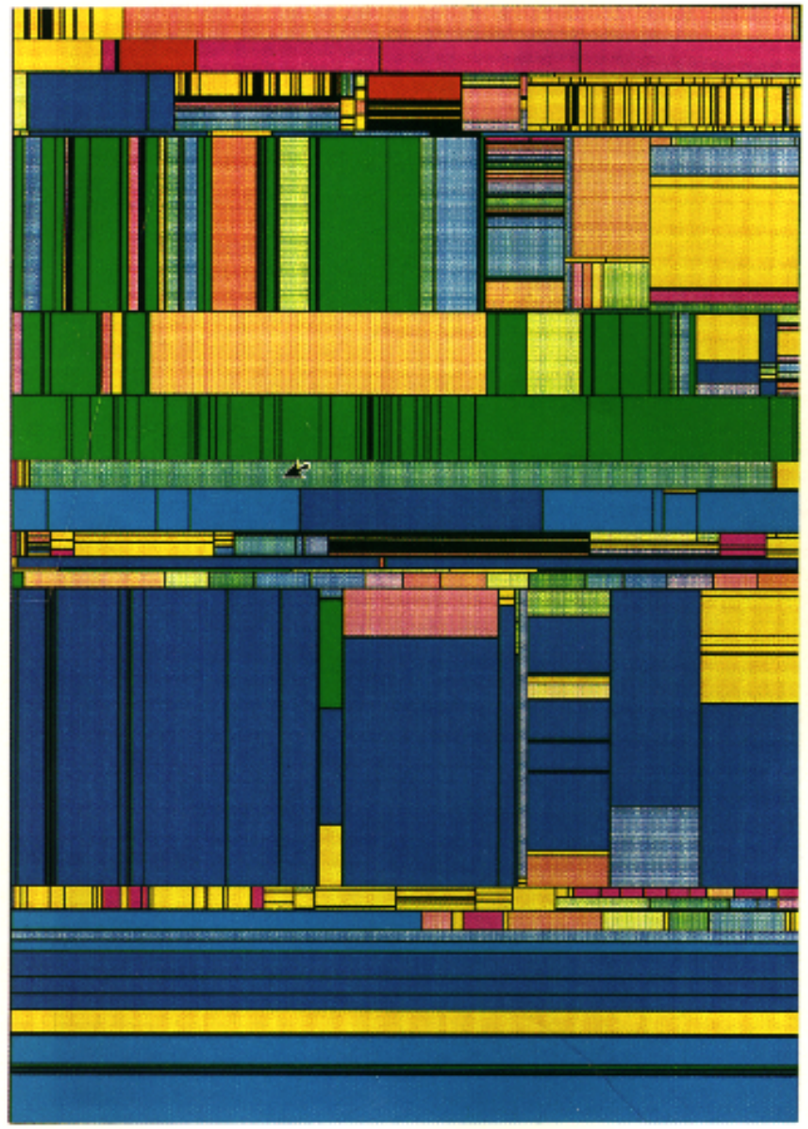


Fig. 4. 850 files at four levels with color coding by tile type. File name pops up when cursor rests on a file.

Treemap

Ben Shneiderman. 1992. Tree visualization with tree-maps: 2-d space-filling approach.
ACM Trans. Graph. 11, 1 (January 1992), 92-99

Figure 10: Enhanced AW Voronoi Treemap layout of 4075 nodes at 10 hierarchy levels (a brighter color indicates a lower hierarchy level)

Voronoi Treemap

Michael Balzer, Oliver Deussen, "Voronoi Treemaps," Information Visualization, IEEE Symposium on, p. 7, 2005 IEEE Symposium on Information Visualization (InfoVis 2005), 2005

# Activity

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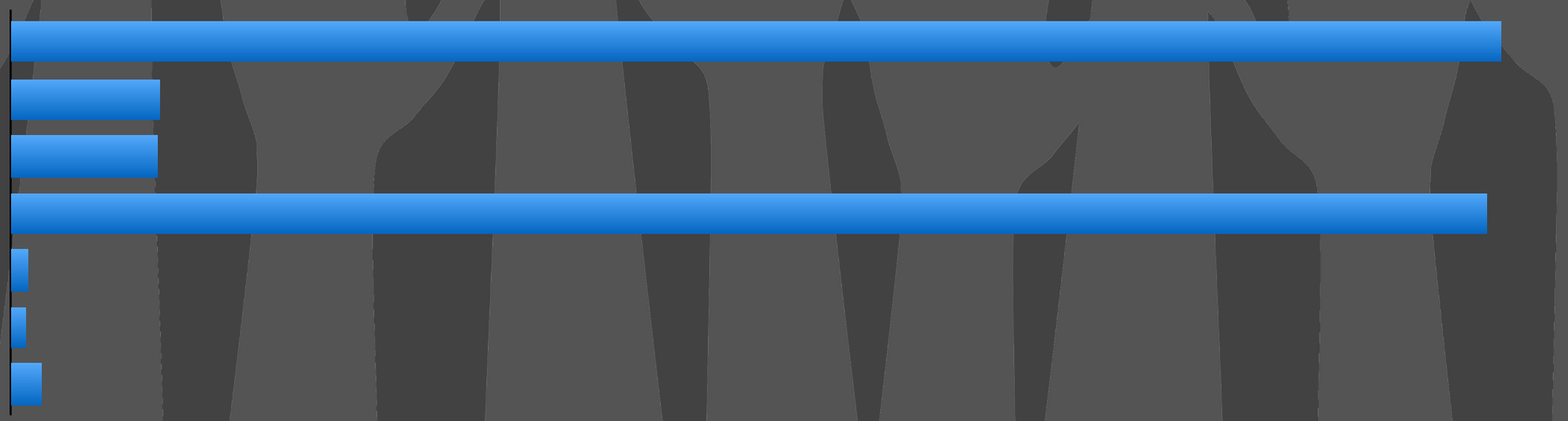
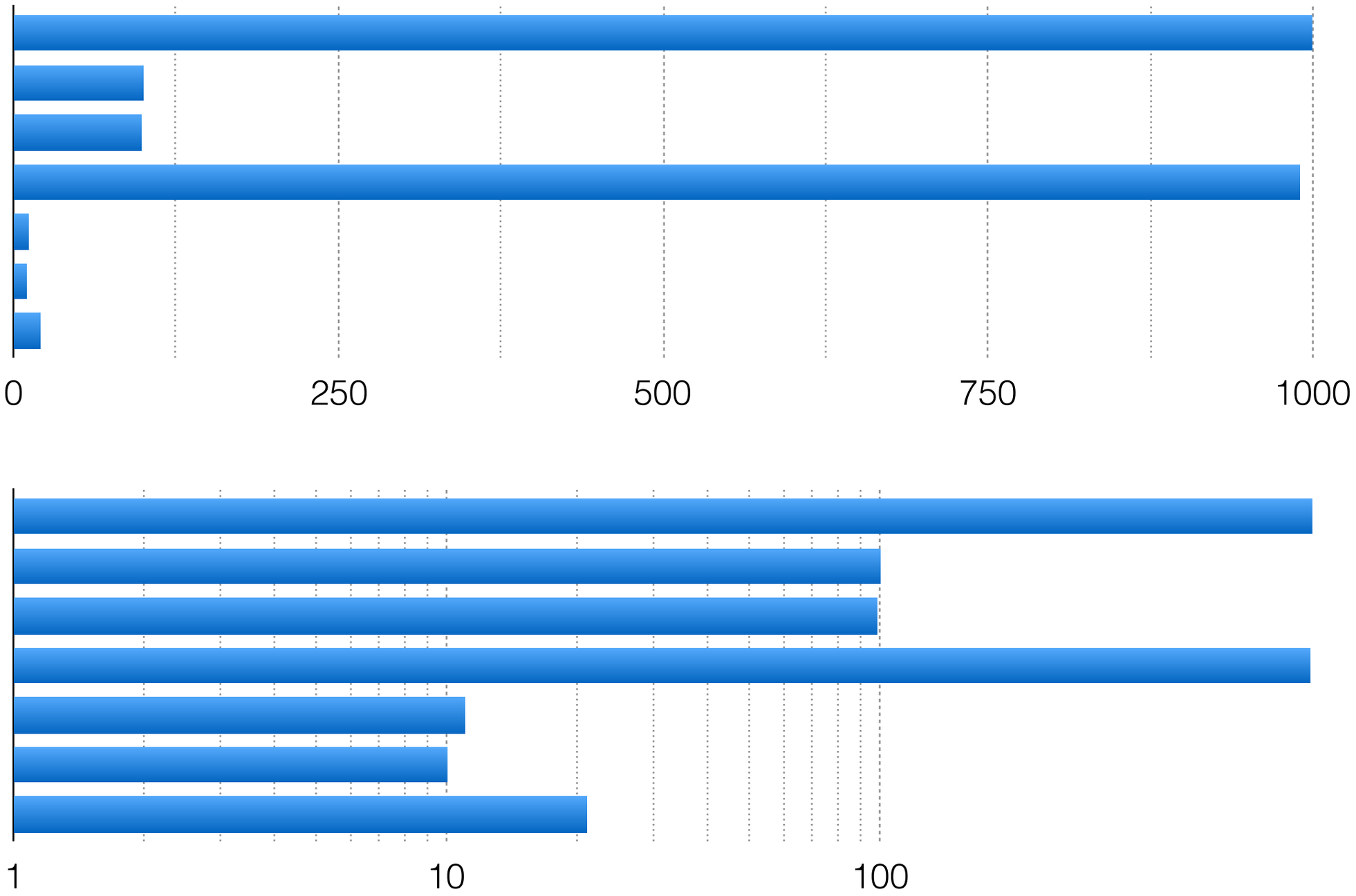
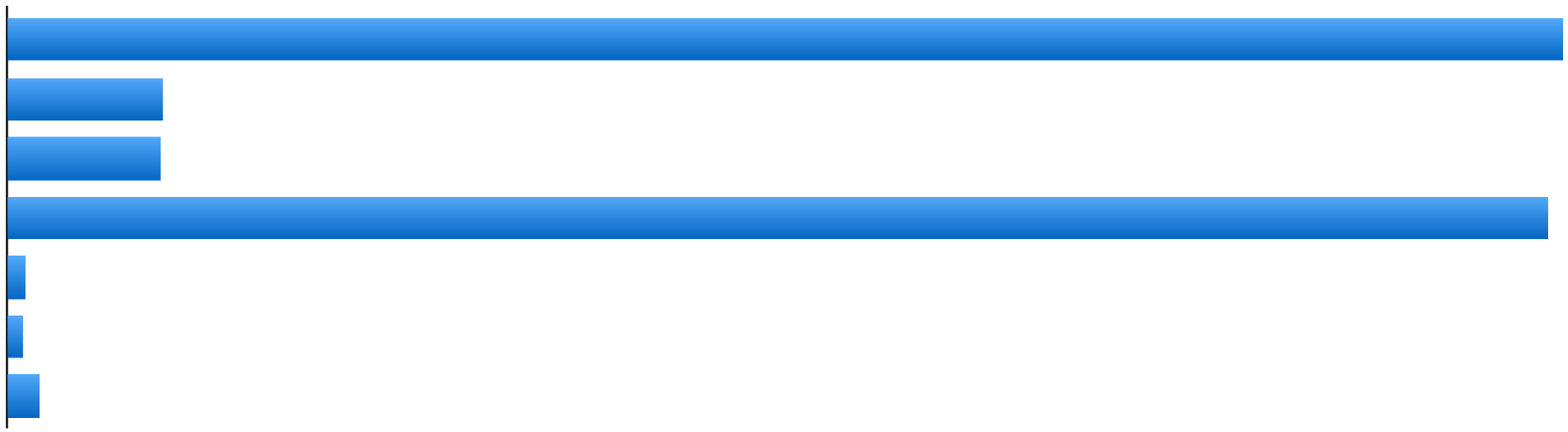
You want to visualize your data with a bar chart. Unfortunately your data values can be very large but a also very small. Sketch two alternative (interactive) visualizations that allow comparison of large and small in one view. [5 min]



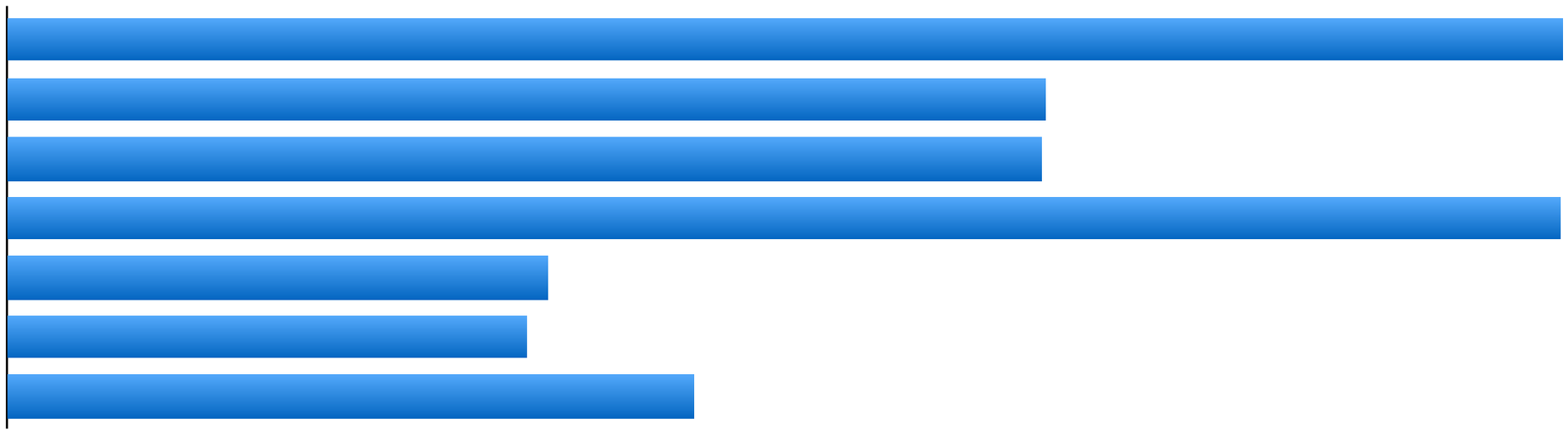
# Log Scale



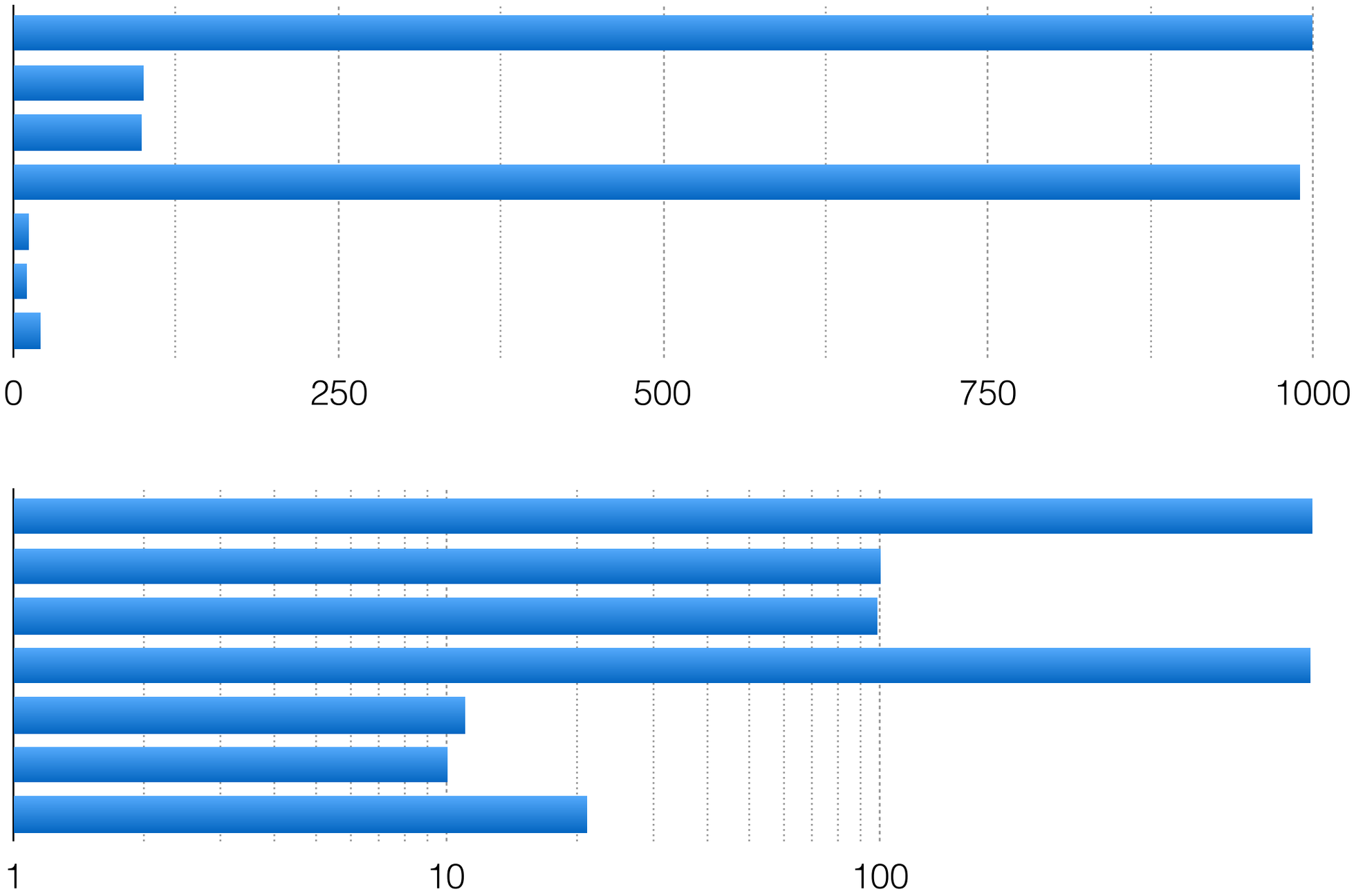
# Log Scale



**Don’t forget labels and ticks!!!**



# Log Scale

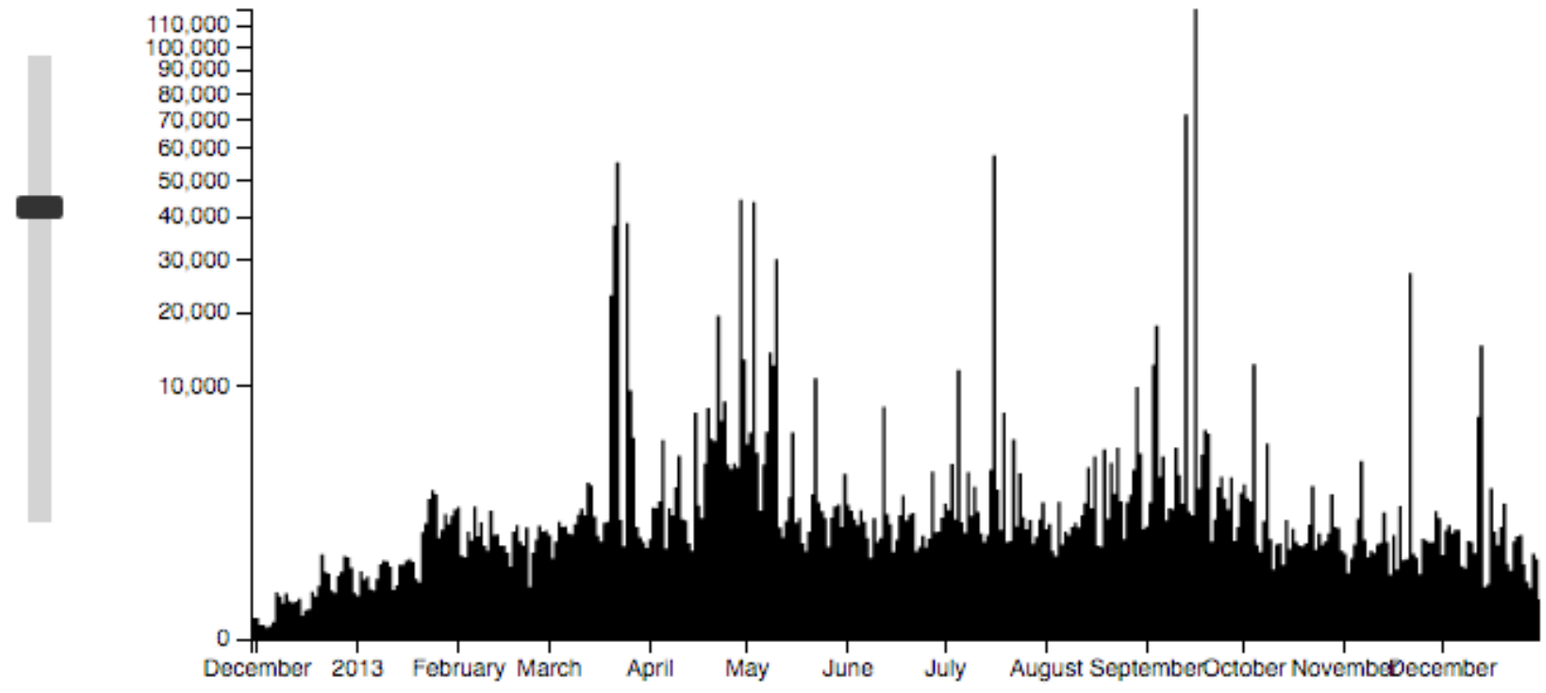


# Axis distortion

$y_{display} = \alpha \cdot y_{data}$ linear scale

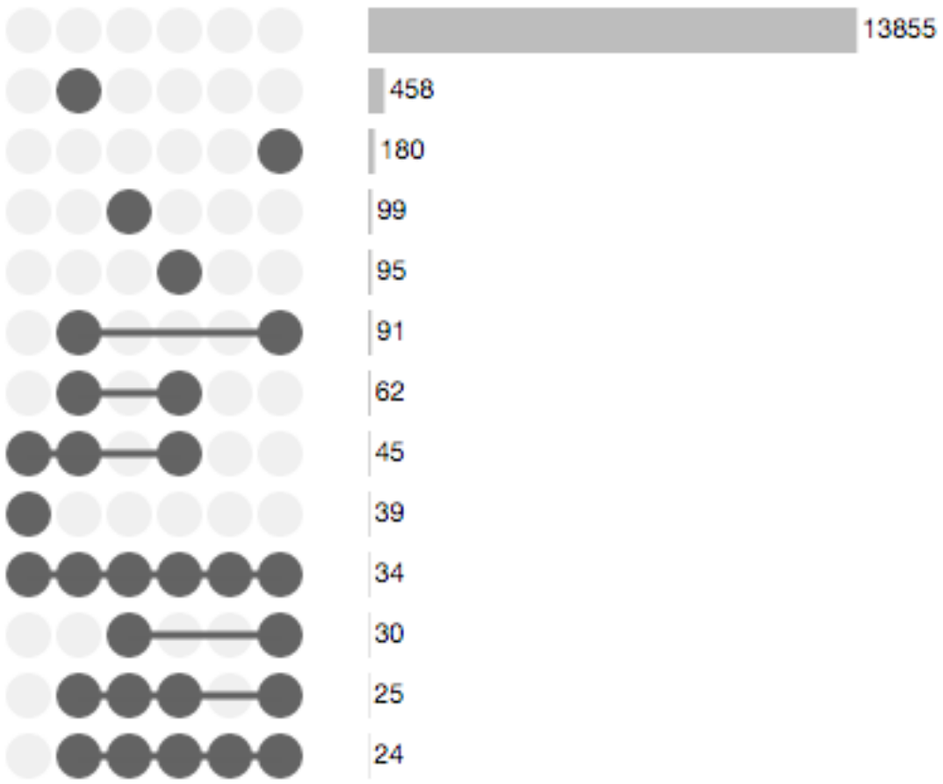
$y_{display} = \alpha \cdot \log(y_{data})$ logarithmic scale

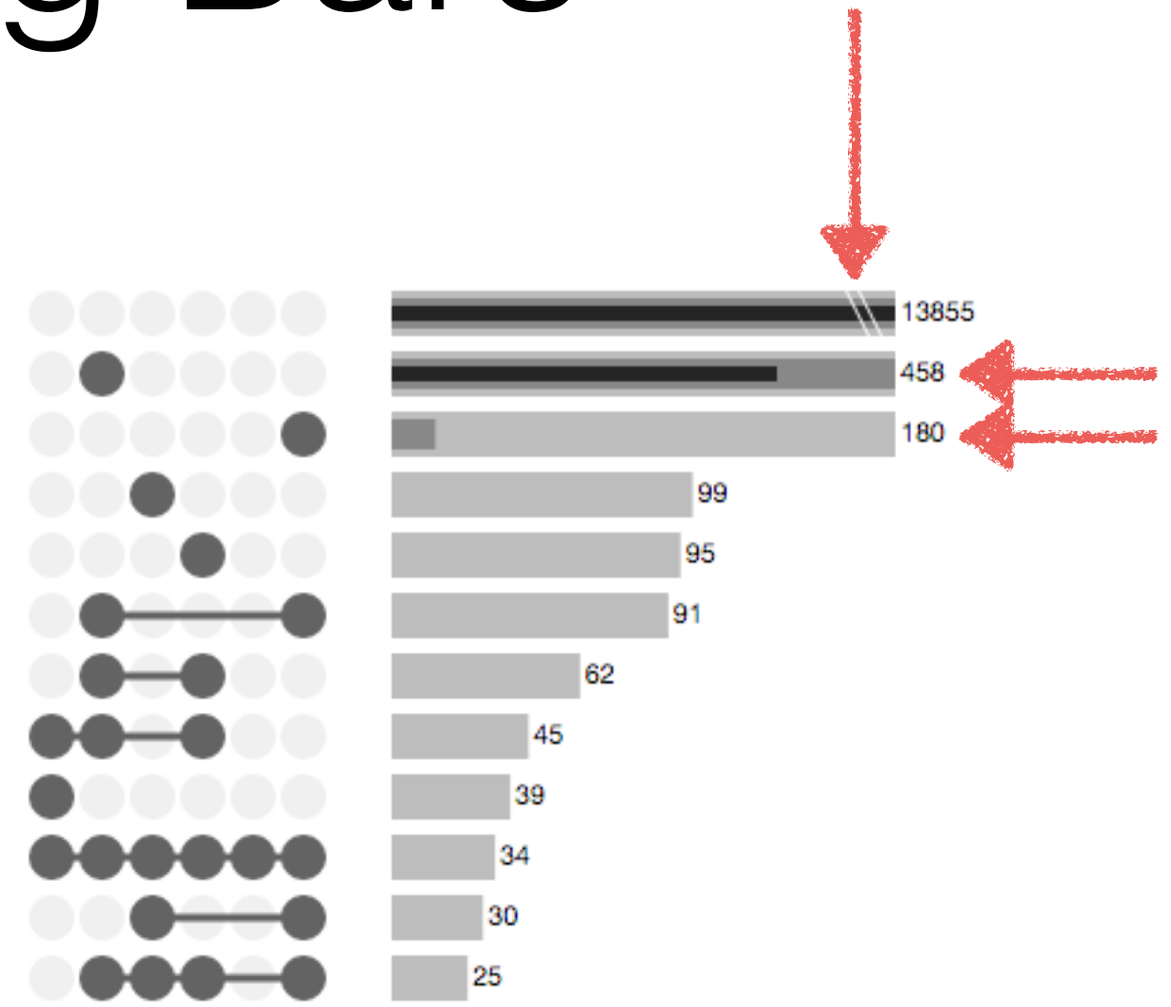
$y_{display} = \alpha \cdot (y_{data})^{e}$ power scale




http://vcglab.org/MyWorld/

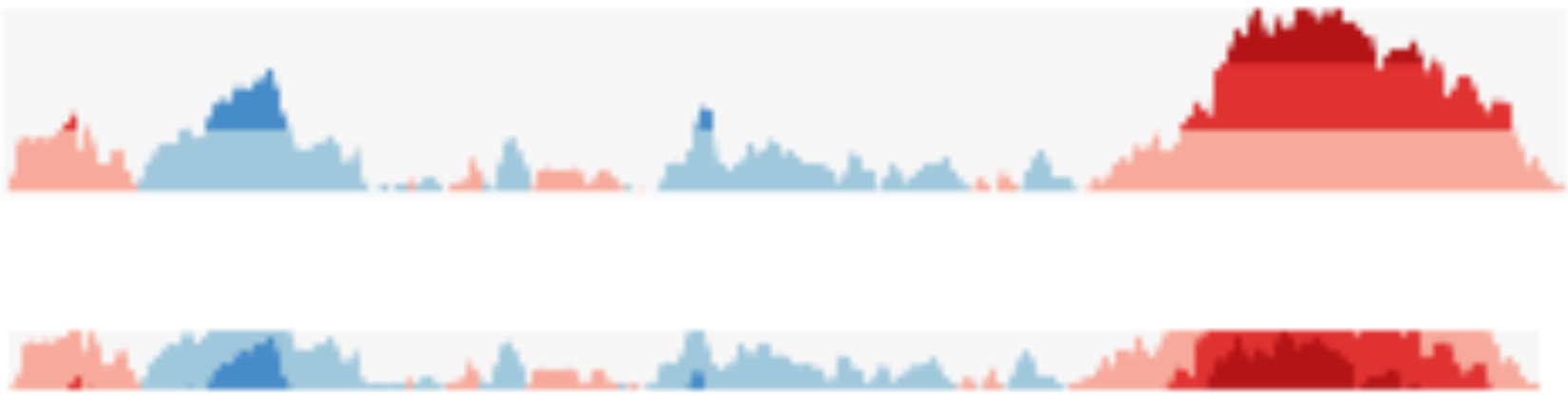
# Wrapping Bars




http://vcg.github.io/upset/?dataset=5&duration=1000&orderBy=subsetSize&grouping=undefined&selection=

# Use existing techniques as inspiration

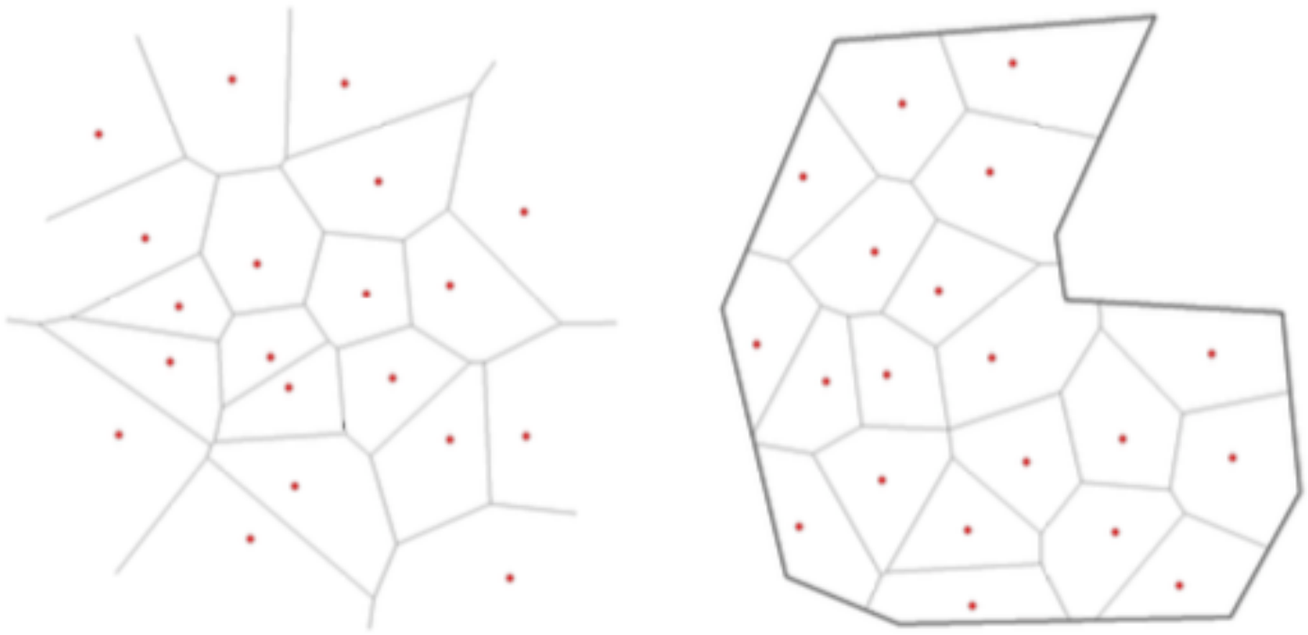


Horizon Graph

https://youtu.be/dMYKEdNgDCE?t=12s

Reijner, Hannes. "The development of the horizon graph." (2008).

# Use existing techniques as inspiration

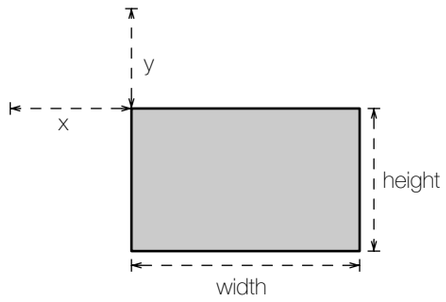


**example:** http://paperjs.org/examples/voronoi/

Figure 10: Enhanced AW Voronoi Treemap layout of 4075 nodes at 10 hierarchy levels (a brighter color indicates a lower hierarchy level)

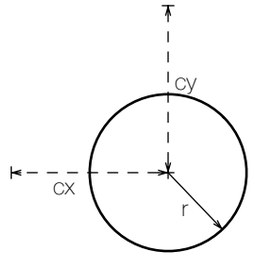
# Decompose Ideas Into SVG elements / D3 objects

## Rectangle



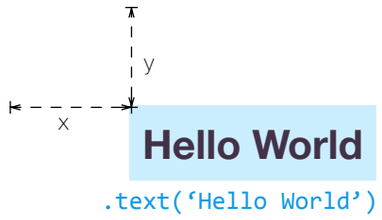

```
<rect x=‘’ y=‘’ width=‘’ height=‘’>
```

## Circle




```
<circle cx=‘’ cy=‘’ r=‘’>
```

## Text




`.text(‘Hello World’)`

```
<text x=‘’ y=‘’>
Hello World
</text>
```

## Image


```
<image x=‘’ y=‘’
width=‘’ height=‘’
xlink:href=’x.png’>
```

## Line



## Transform `.attr(‘transform’,’…’)`

```
translate(x y)
```

## CSS `.style({…})`

```
rect{
   stroke: <color>;
   stroke-width: <width>;
```

## D3 generators

`d3.svg.line()`



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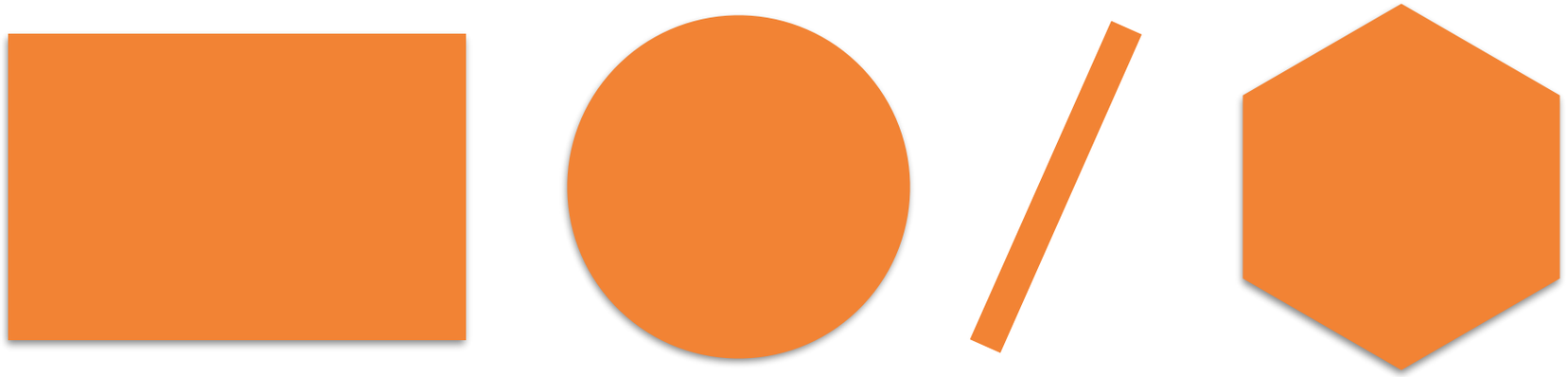
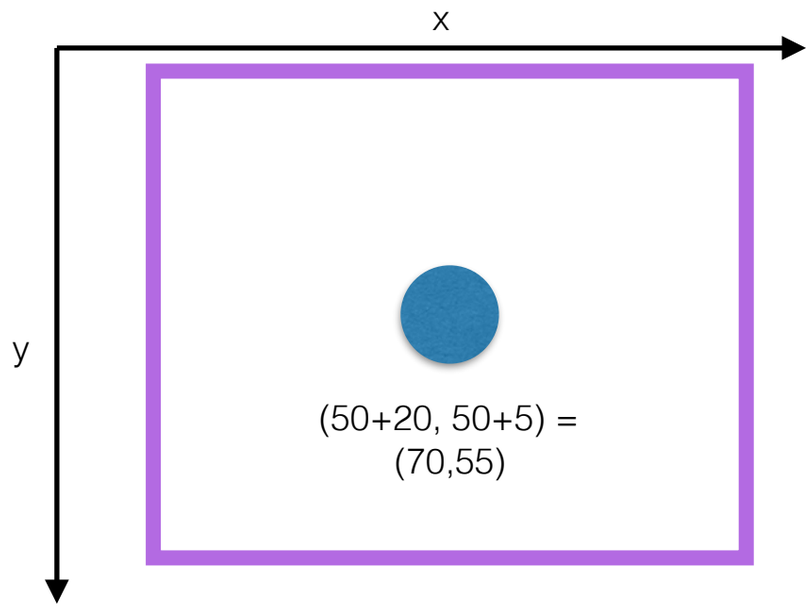
# Toolbox SVG/D3

## Shapes



## Grouping




## Transformations:

- scale
- rotate
- translate

| q1 | q2 | … | comment |
|---|---|---|---|
| 1 | 0 | 1 | hello |
| 0 | 1 | 1 | world |
| **1** | **1** | **2** | **?** |

http://vote.myworld2015.org/

= votes below average  = votes above average  add own term:  search


http://hendrik.strobelt.com/Prio17Combined/


*

...

... AND ((countryFull:"united states of a

... AND (countryFull:"zimbabwe")

... AND (countryFull:"united states of a

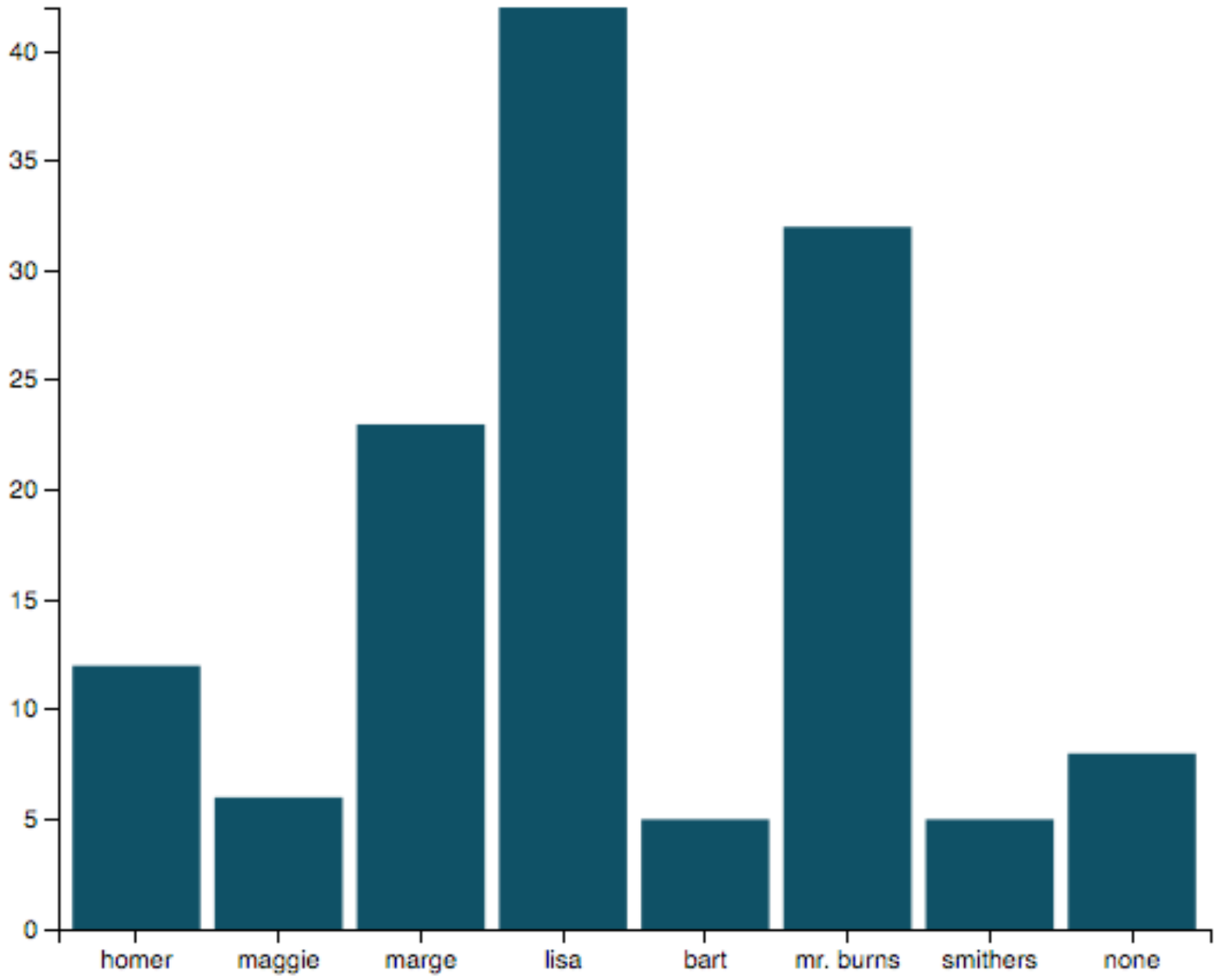
**... AND (countryFull:"australia")**

... AND (countryFull:"united kingdom of

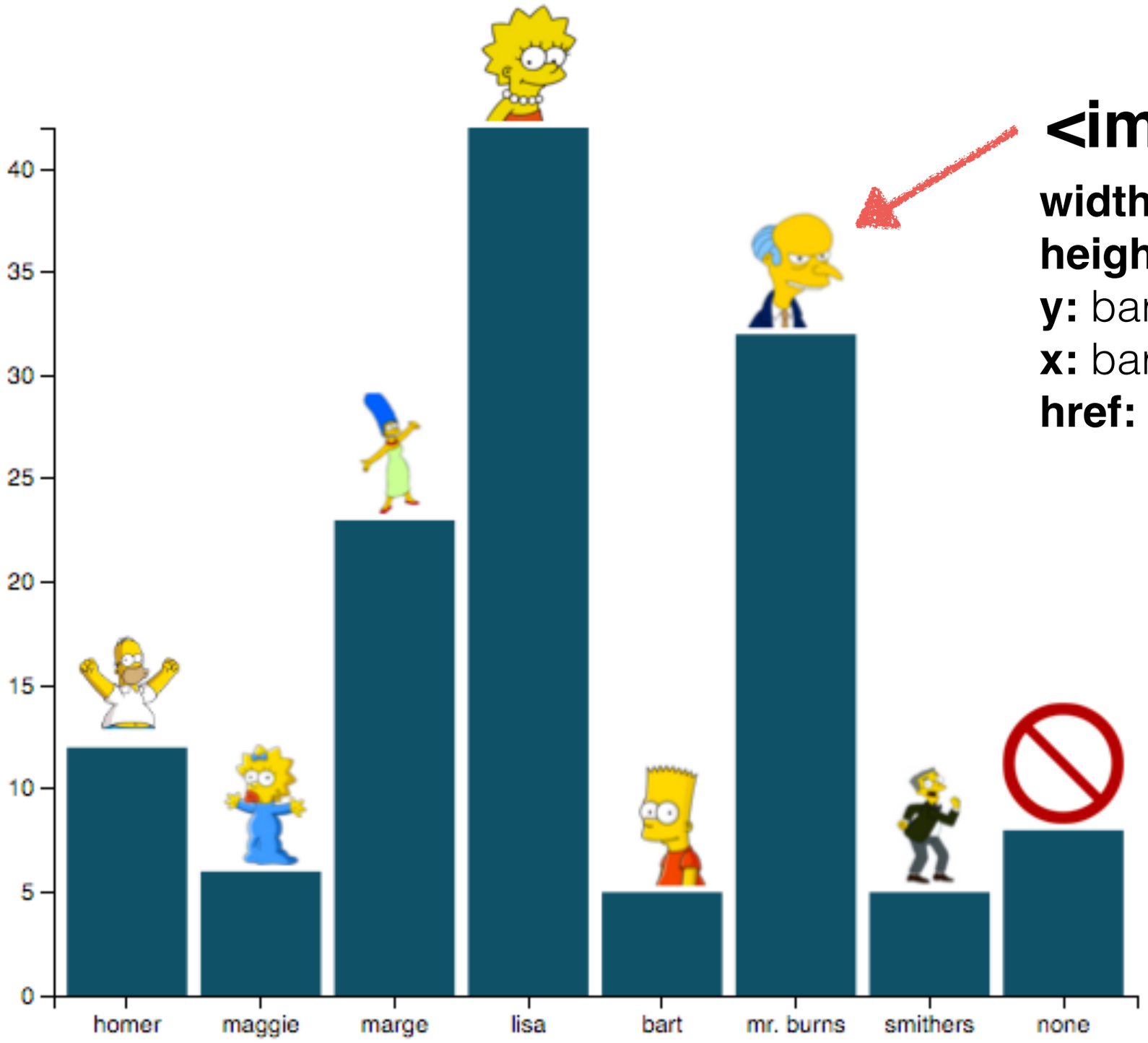
... AND (countryFull:"brazil")

... AND (countryFull:"united states of a

# Examples


40
35
30
25
20
15
10
5
0
homer
maggie
marge
lisa
bart
mr. burns
smithers
none

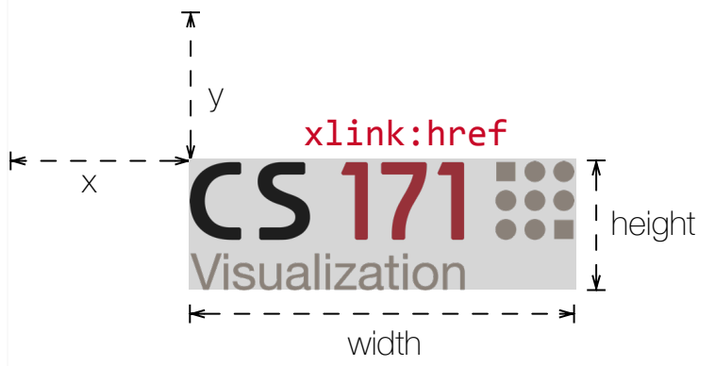
# Example



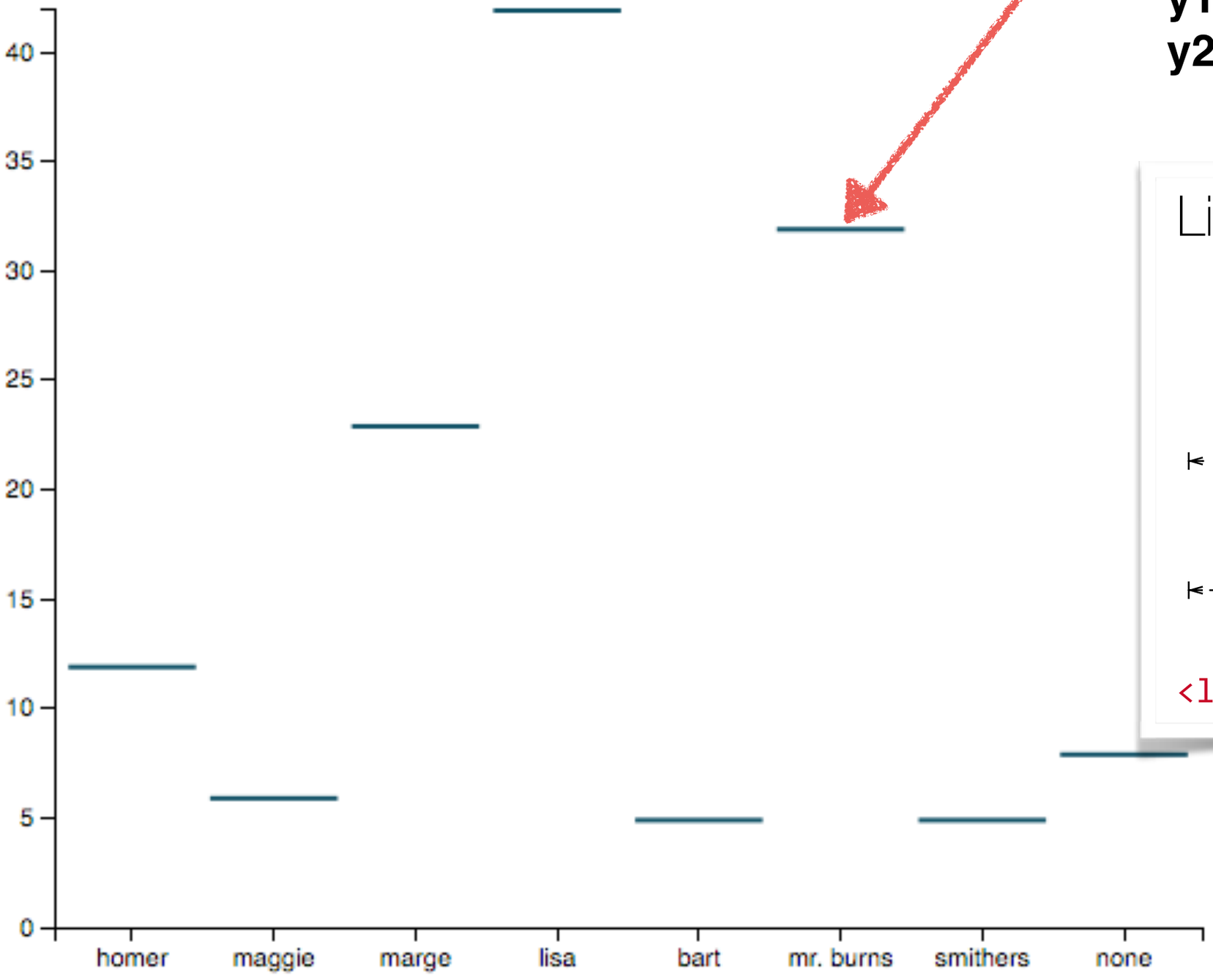

**<image>**

**width:** like one bar
**height:** keep aspect ratio
**y:** bar.top - height - x
**x:** bar.x
**href:** d.file

Image



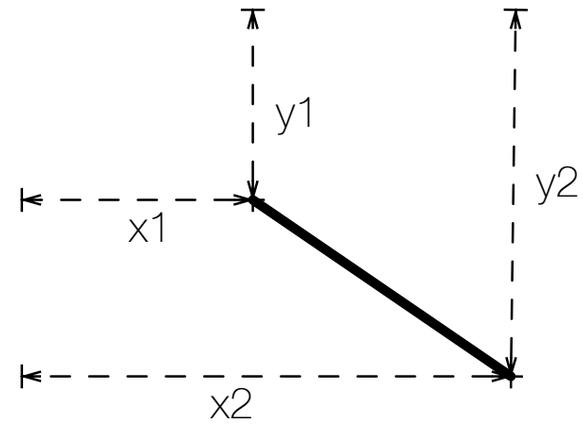

```
<image x=‘’ y=‘’
width=‘’ height=‘’
xlink:href=’x.png’>
```



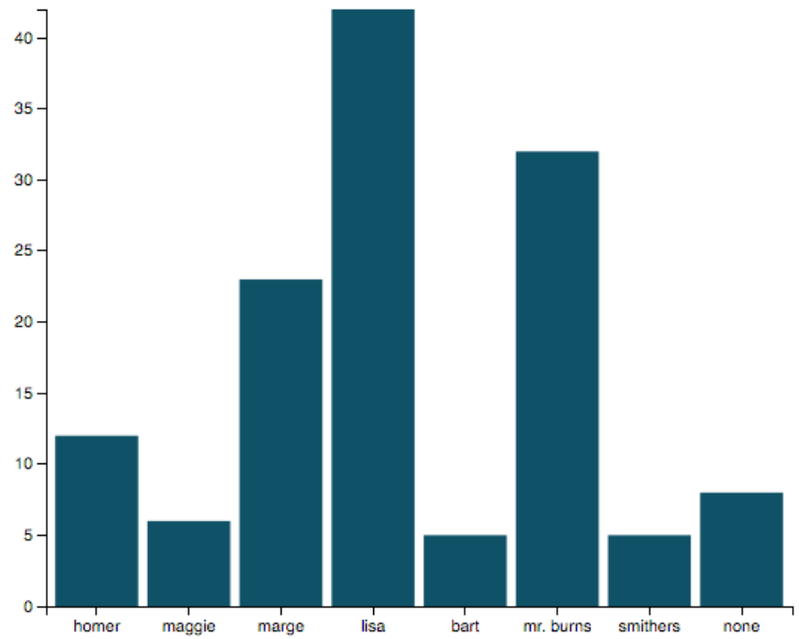

# <line>

**x1:** bar.x
**x2:** bar.x+bar.width
**y1:** bar.top
**y2:** y1

## Line

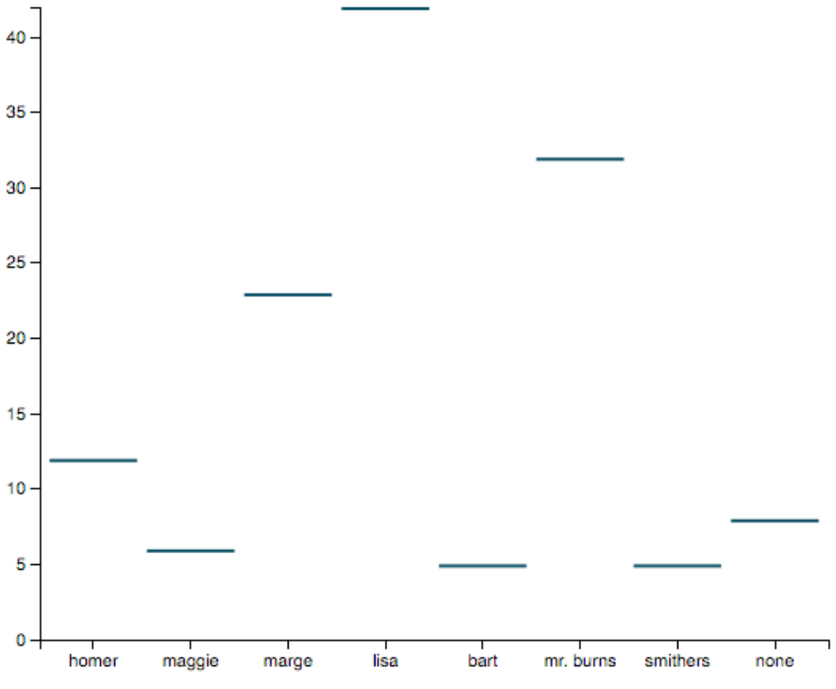



```
<line x1=‘’ y1=‘’ x2=‘’ y2=‘’>
```




```
// --- changing nodes for bars
bars.attr({
    x: function (d) {
        return xScale(d.name);
    },
    y: function (d) {
        return yScale(d.value);
    },
    width: function (d) {
        return xScale.rangeBand();
    },
    height: function (d) {
        return yScale.range()[0] - yScale(d.value);
    }

})
```




```
// --- changing nodes for bars
bars.attr({
    x: function (d) {
        return xScale(d.name);
    },
    y: function (d) {
        return yScale(d.value);
    },
    width: function (d) {
        return xScale.rangeBand();
    },
    height: function (d) {
        return 2;
    }

});
```

# Activity

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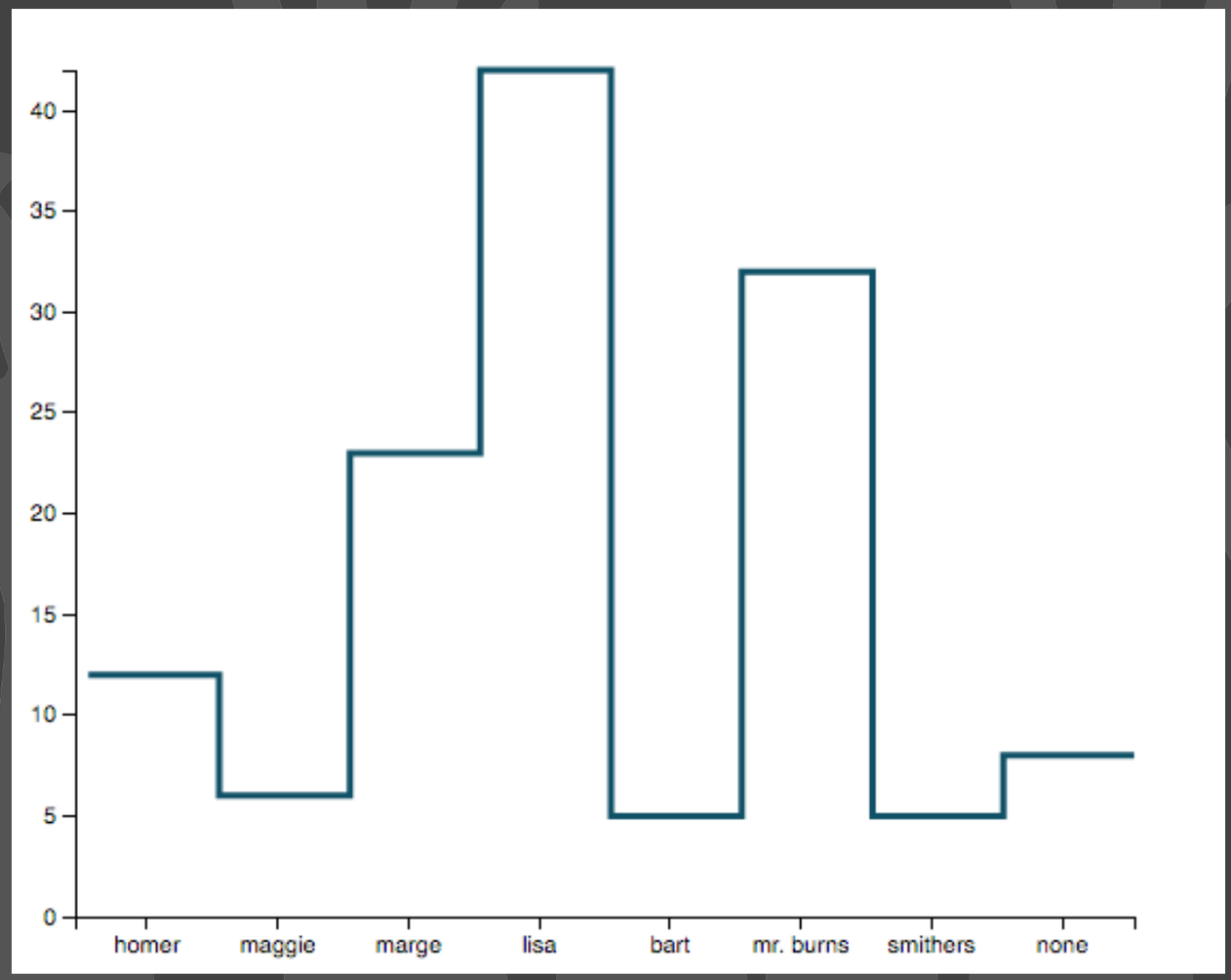
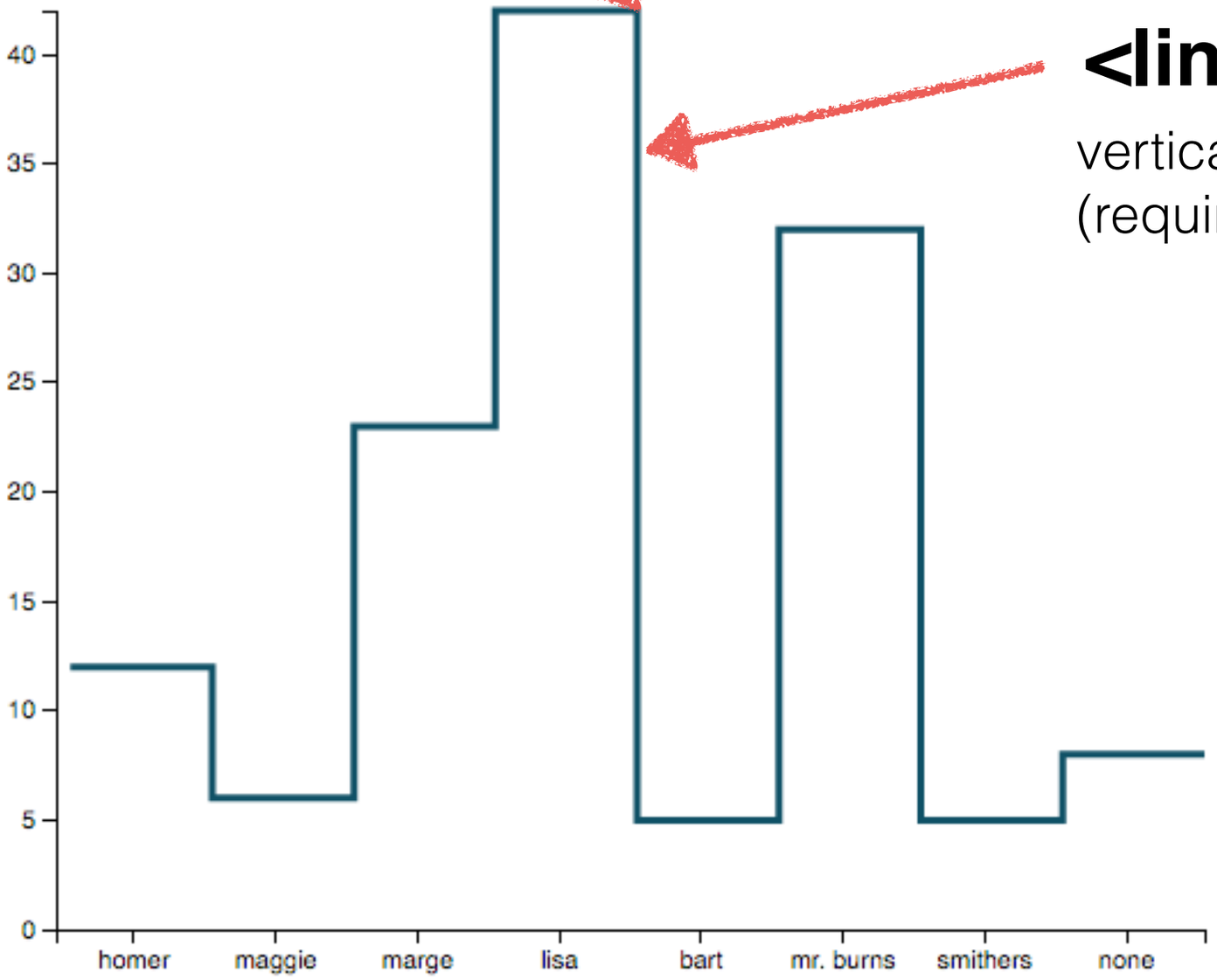
Which primitives would you use to create the following bar chart alternative. Define how you would derive the attributes. [3 min]



# Idea C



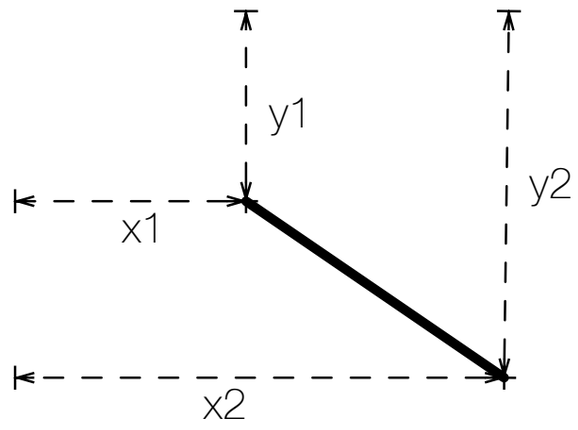

**<line>**

horizontal line with y like bar.top

**<line>**

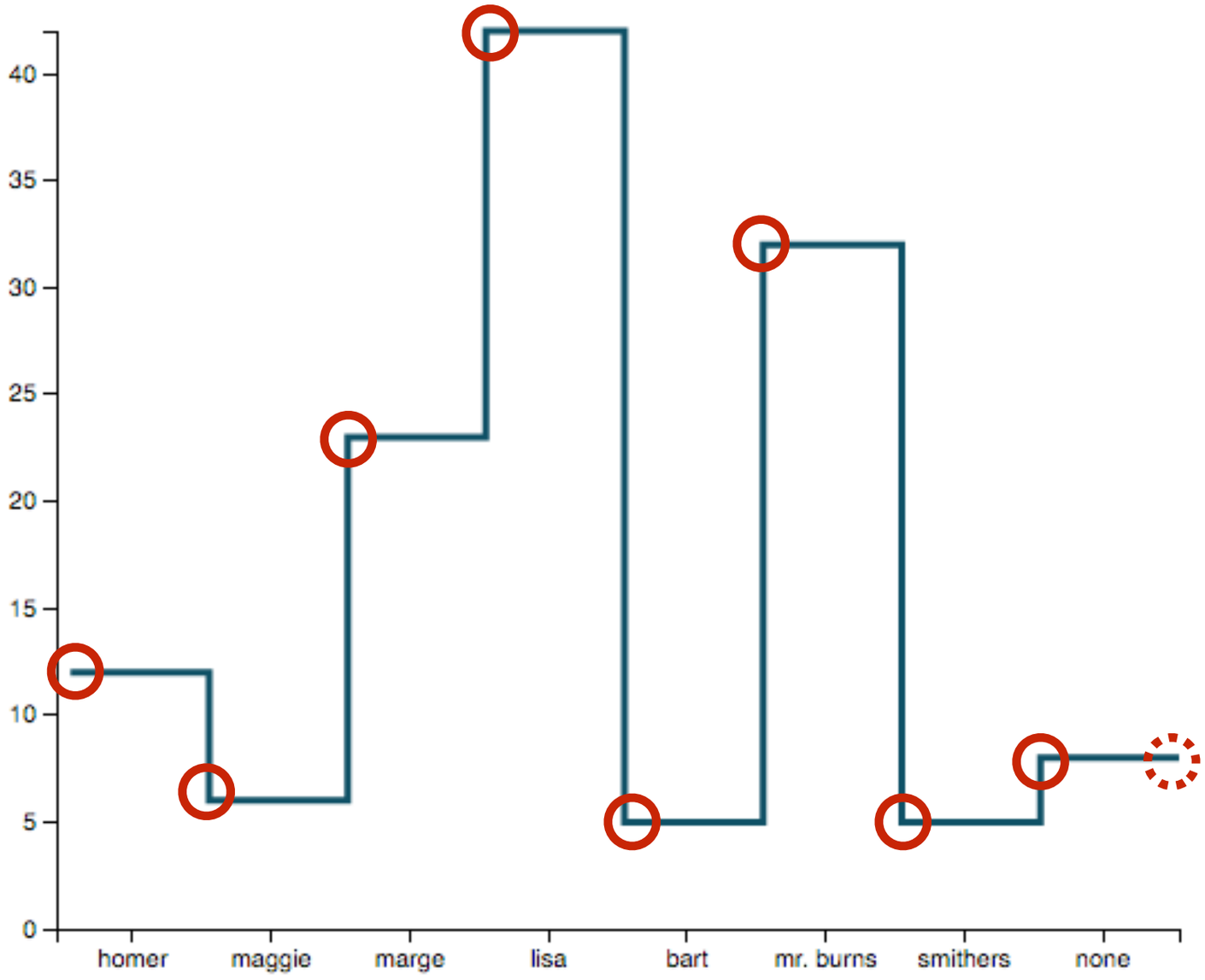
vertical line
(requires new data about changes)

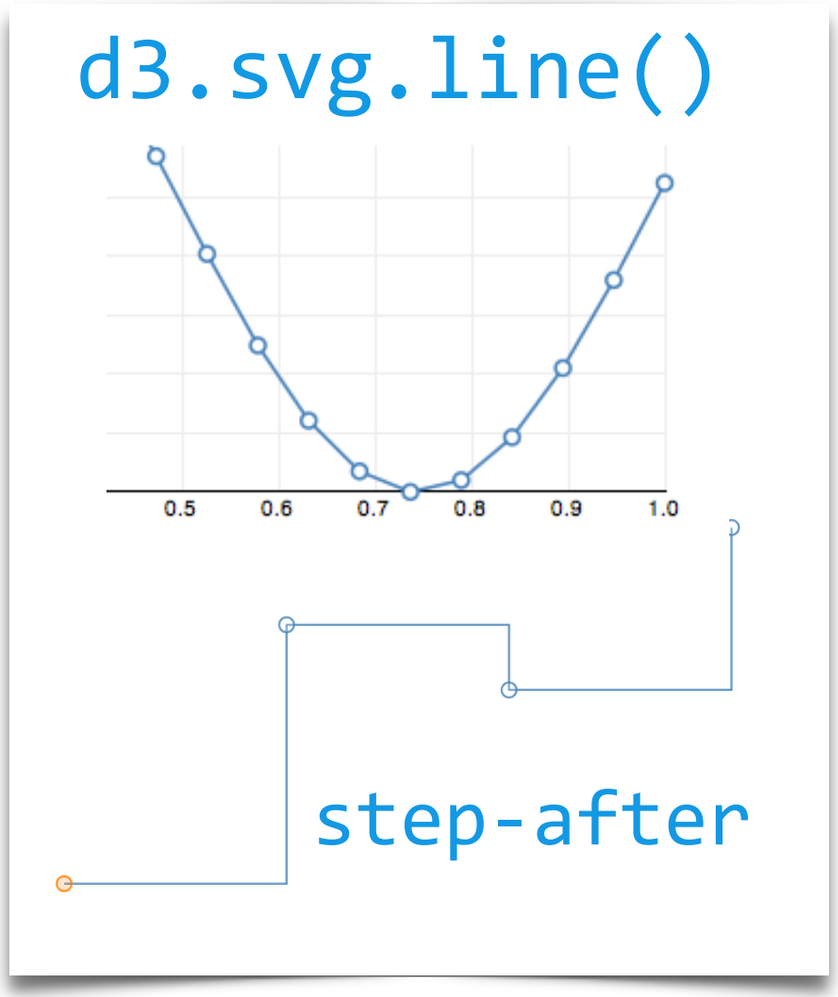
## Line




```
<line x1=‘’ y1=‘’ x2=‘’ y2=‘’>
```

# Idea C

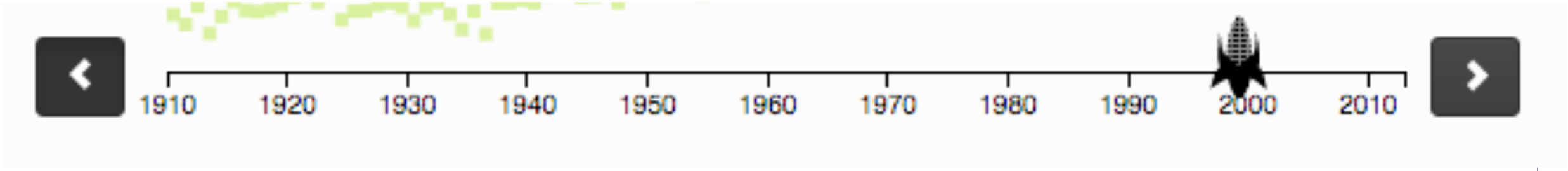

40
35
30
25
20
15
10
5
0
homer
maggie
marge
lisa
bart
mr. burns
smithers
none


d3.svg.line()
0.5
0.6
0.7
0.8
0.9
1.0
step-after

# Examples

## The corn slider (CS171 Hall of Fame 2014)

http://jbencook.github.io/cs171-ag-viz/src/CountyData.html




## People Quantities (Midterm 2016):

# Triggering Innovation

- **Approach 1:** Evaluate your (paper) prototype and identify weak parts.

E.g.:

- How can I increase visibility of X ?
- What helps communicating my message?
- What makes my vis unique?

# Triggering Innovation

- **Approach 2:** Imagine having limited resources or constraints. Have a group exercise to sketch alternatives and discuss them.

E.g.:

- How can I show my geographical data without a map?
- How can I show key phrases without a word cloud?

# Your Projects

- Implement multiple coordinated (linked) views
- New this year: Implement at least one innovative view that is either
  - a) an extension of an existing visualization type, or
  - b) a novel visualization type

# Practical Considerations

```
// life motto
if (sad() === true) {
 sad().stop();
 beAwesome();
}
```

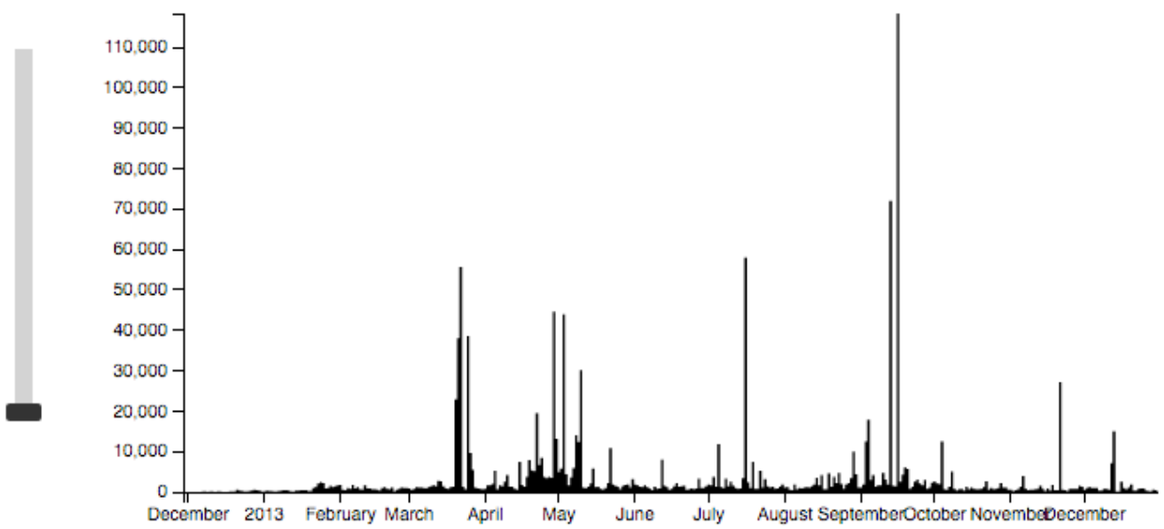
CS 171

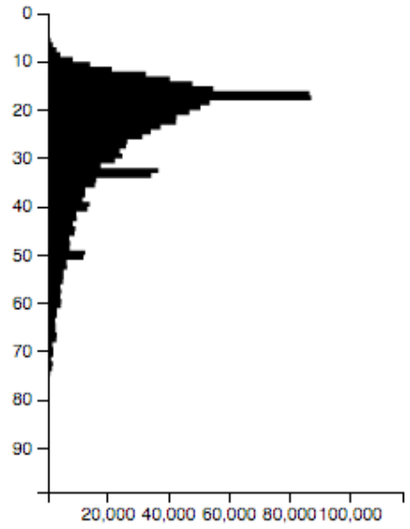
# MyWorld 2015 Data Visualization

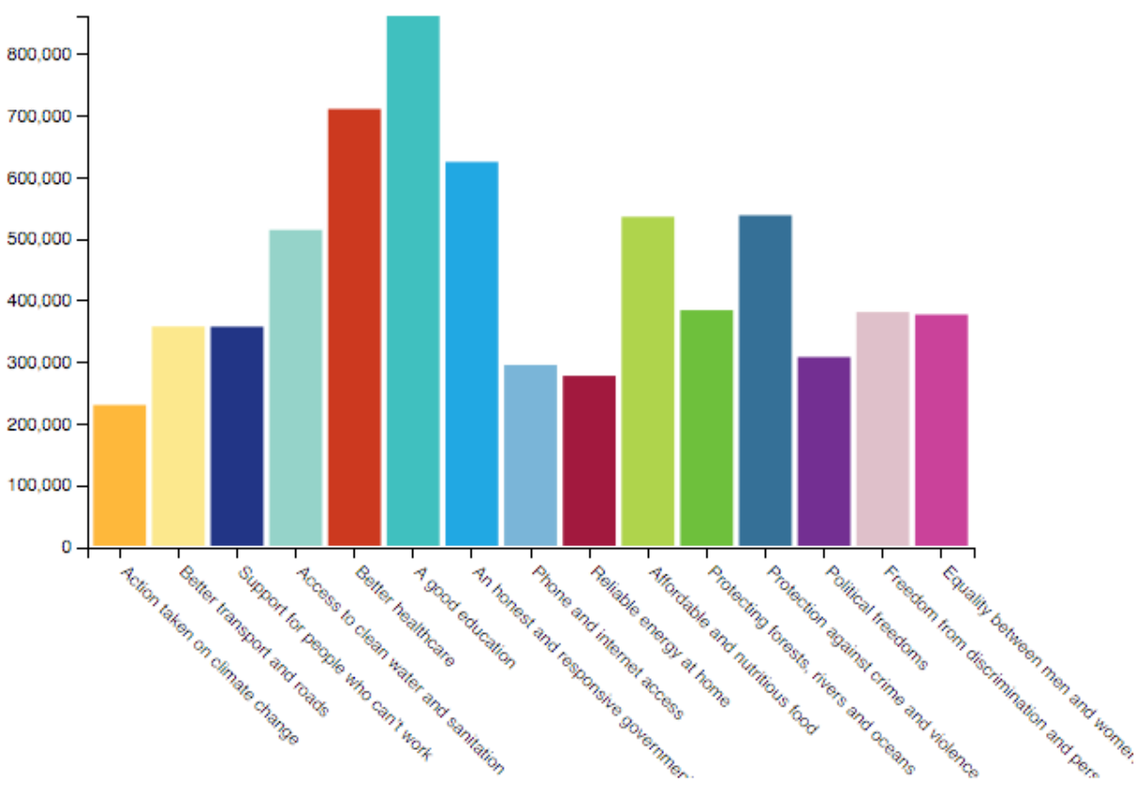
The following visualization shows you the votes for MyWorld 2015. You can select a time range to see changes in the distribution of votes und distribution of age of the voters.

↔ reset zoom

**current brush:**

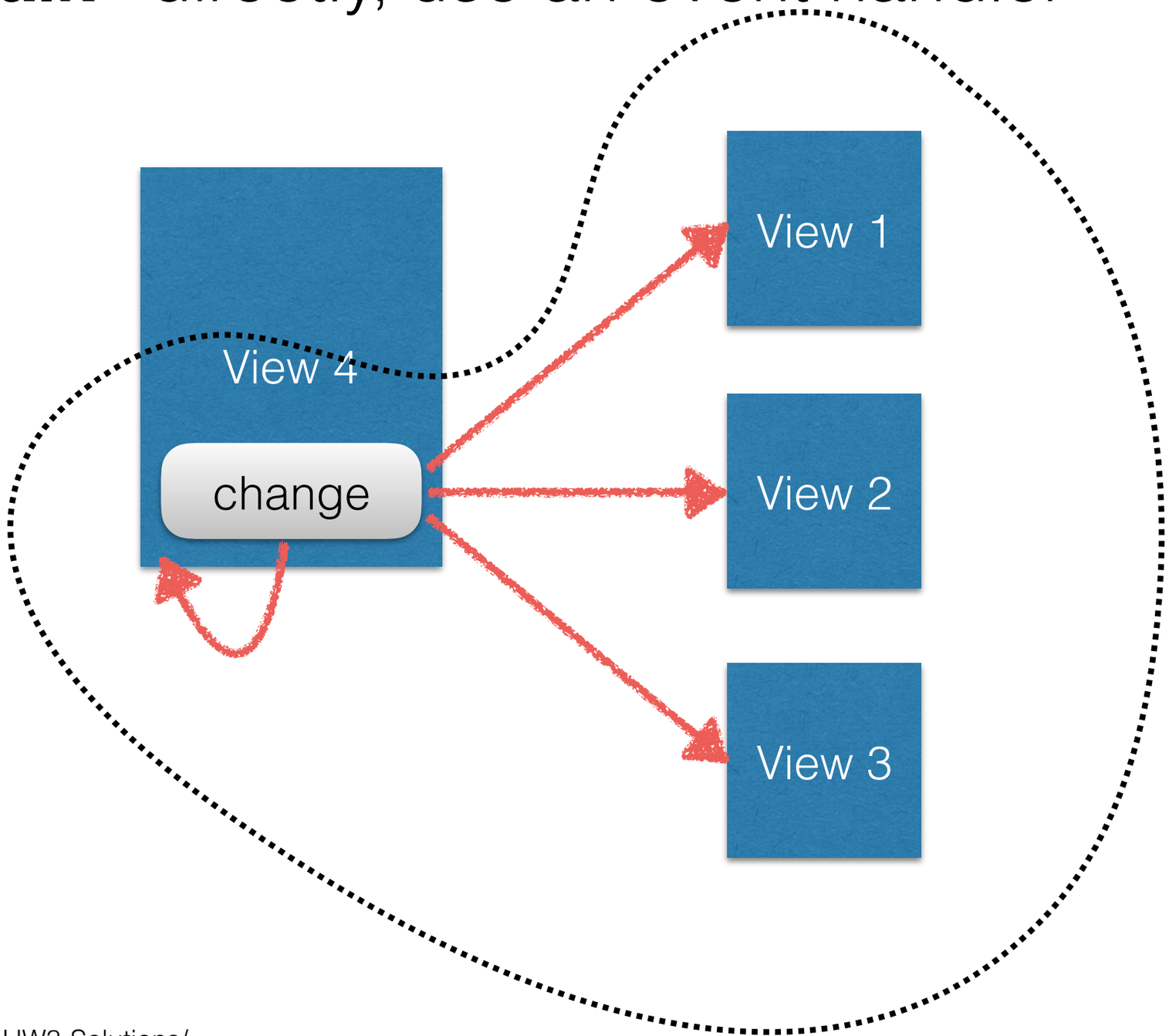


# Communication between views

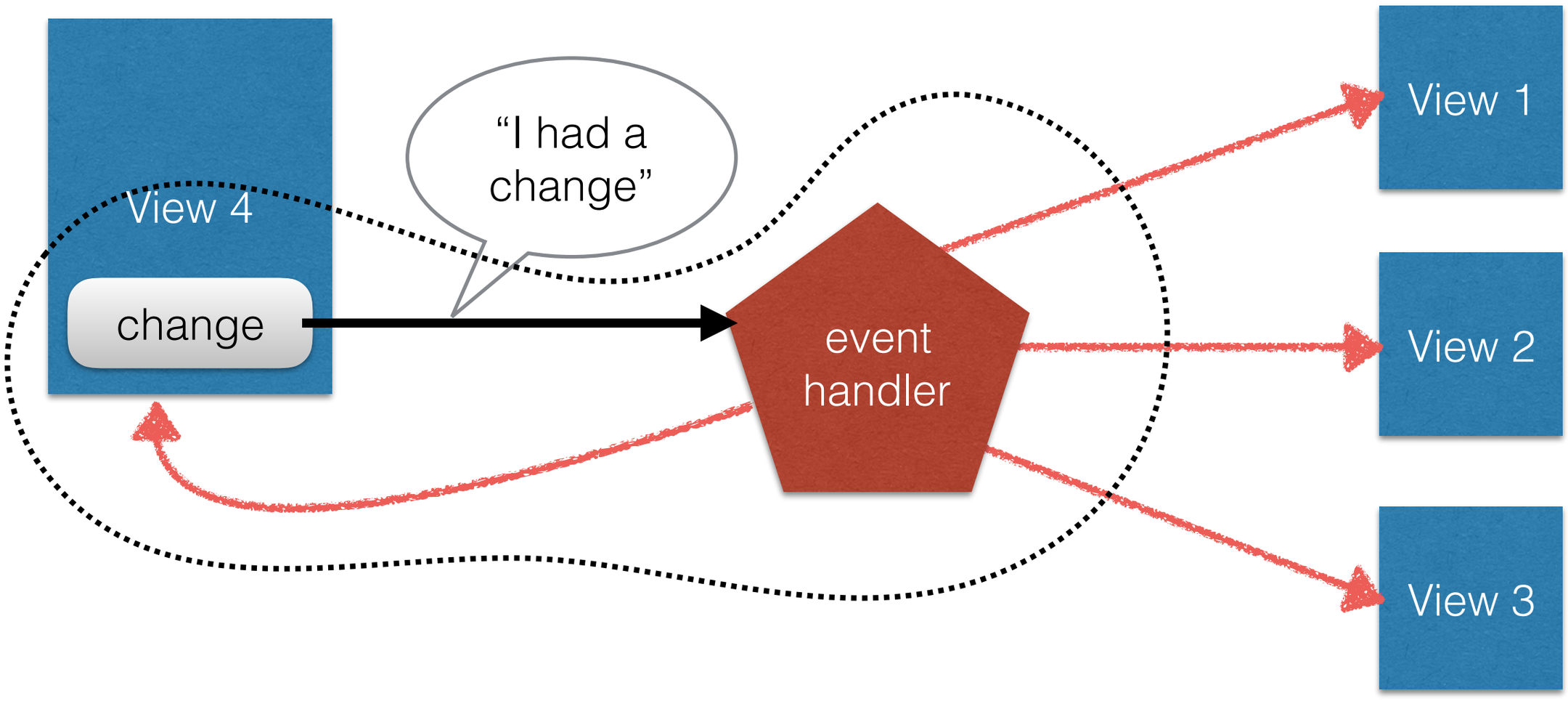
- Don’t **“talk”** directly, use an event handler




**example:** http://vcglab.org/2015-HW3-Solutions/

# Communication between views

- Don't **"talk"** directly, use an event handler




**example:** http://vcglab.org/2015-HW3-Solutions/

# Today

**1 min paper**

- Evaluation
- Innovation
- Innovation with D3

# That’s not all, folks.

| | | | | |
|---|---|---|---|---|
| Week 11 (4/4-4/10) | Final Project Plan | **Evaluation, Innovation, Innovate in D3** | **Javascript Frameworks.** Data APIs. | Project re-design |
| Week 12 (4/11-4/17) | Project re-design | **Project Office Hour - Last Minute Questions on Implementation** | **Guest Lecture - Fathom Design (mandatory attendance)** | Project peer feedback |
| Week 13 (4/18-4/24) | Project prototype V1 | **Guest Lecture - Terry Yoo (mandatory attendance)** | **Guest Lecture - Martin Wattenberg (mandatory attendance)** | Peer usability evaluati |
| Week 14 (4/25-5/1) | Project prototype V2 | **Project Demos (mandatory attendance)** | reading period | reading period |
| Week 15 (5/2-5/8) | Final project V2 | reading period | **Wednesday 5/4: SEAS design fair, final project demos (mandatory attendance)** | |

## This Thursday…

- Javascript Frameworks. Data APIs.
- Reading:  jQuery tutorials (see Canvas)

## Next Tuesday…

- Project Office Hour - Last Minute Questions
- Reading:  —

## Project (due Monday)…

- Project Re-Design