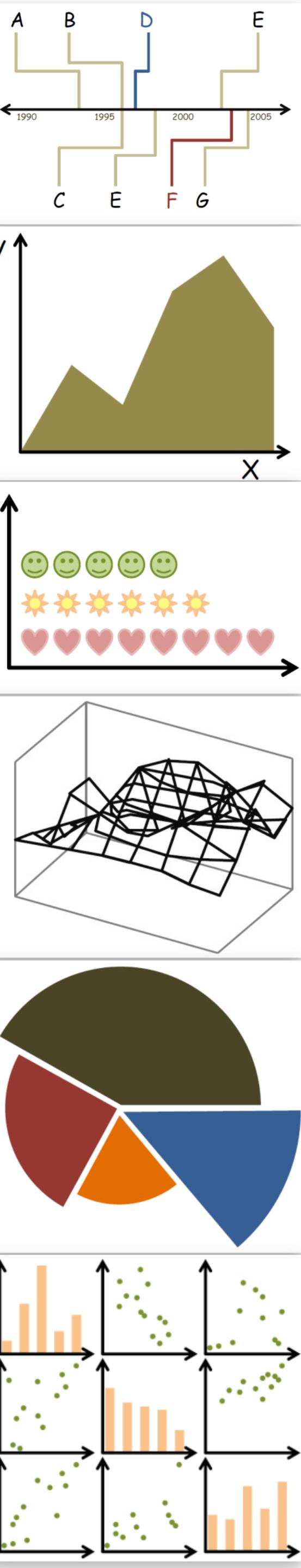


Lecture 8: Visual Encodings

DS 4200
FALL 2022

Prof. Ab Mosca (*they/them*)
NORTHEASTERN UNIVERSITY

Slides and inspiration from Cody Dunne, Michelle Borkin, Dylan Cashman, Krzysztof Gajos, Hanspeter Pfister, Miriah Meyer, Jonathan Schwabish, and David Sprague



Last Class

We:

- Worked on D3

Any Questions?

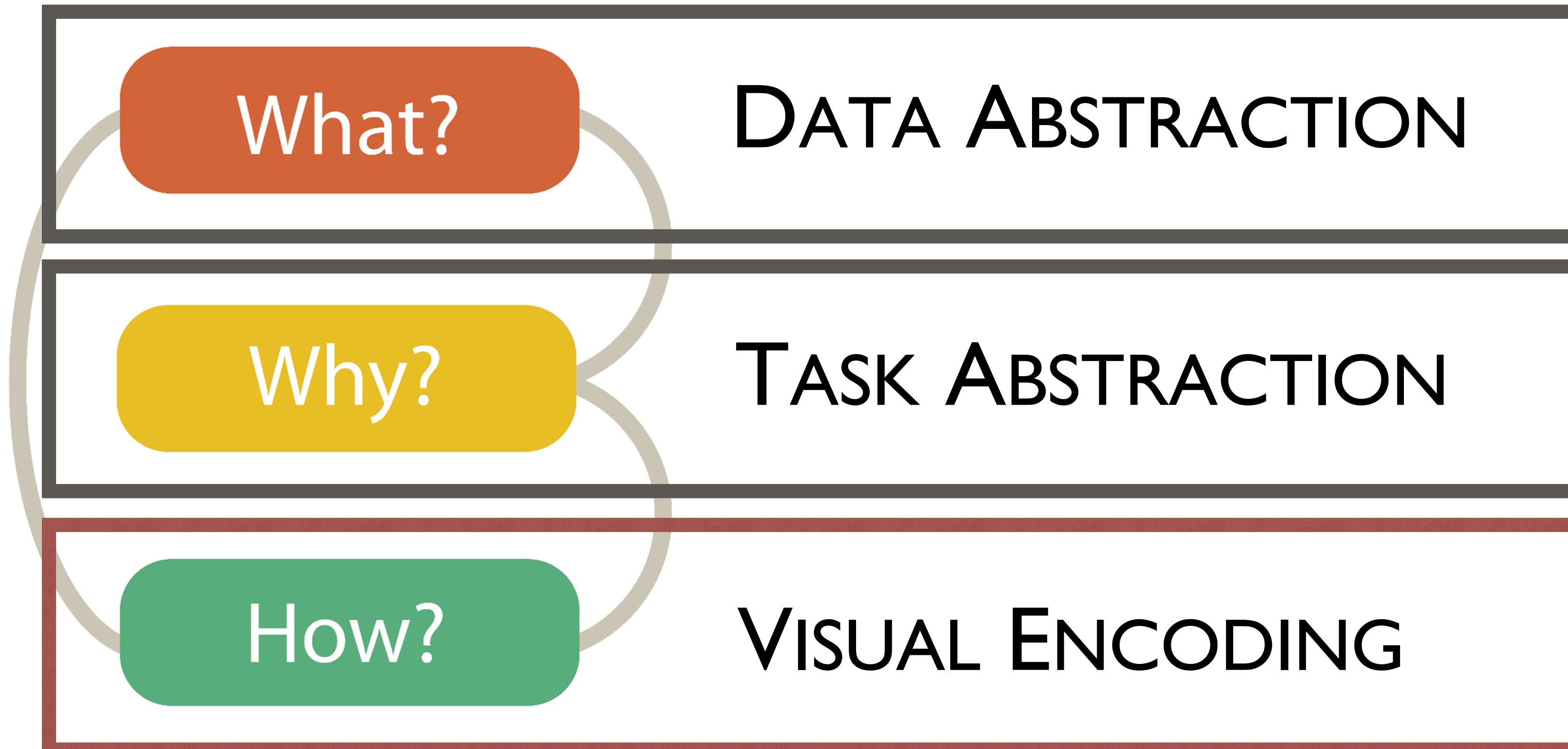
Today

- Visual Encodings (for tables)
- Sketching new visualizations \ iterative design

VISUAL ENCODINGS

From Munzner's book

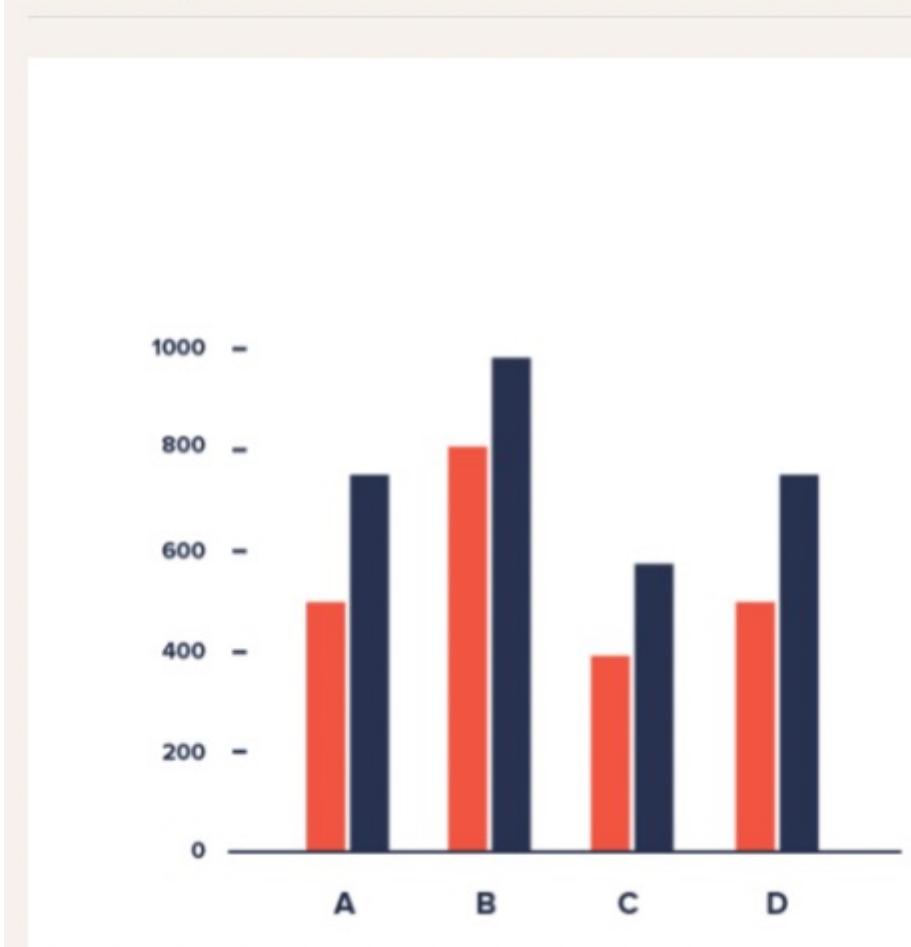
Visualization Building Blocks



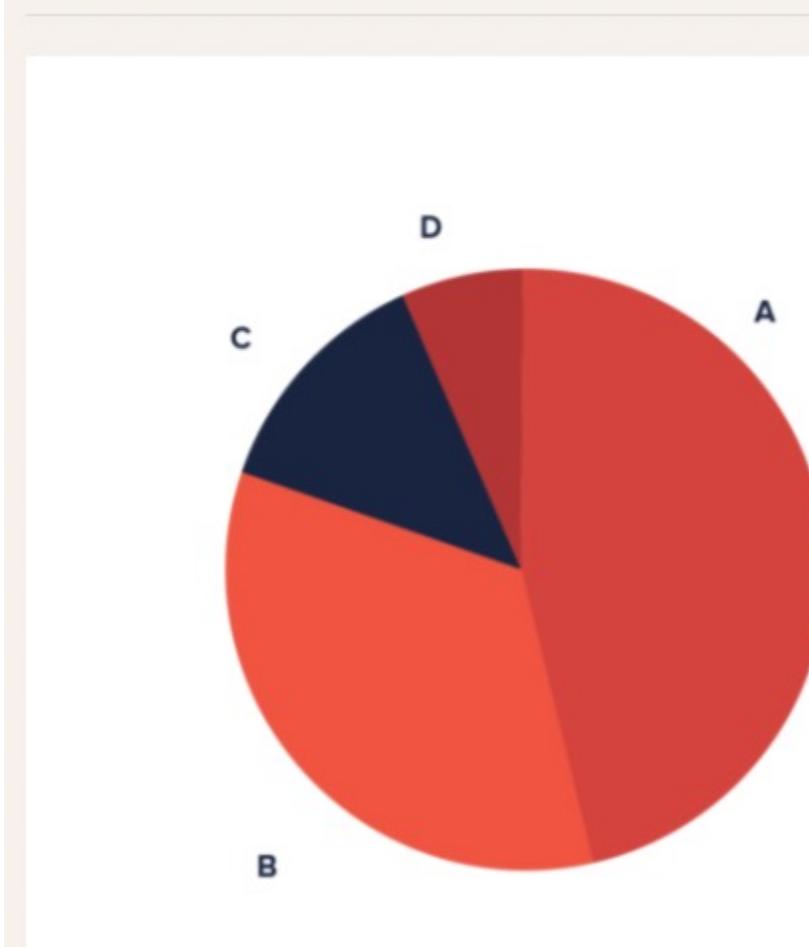
Visual Encoding

What is it? The literal representation of data in a visualization.

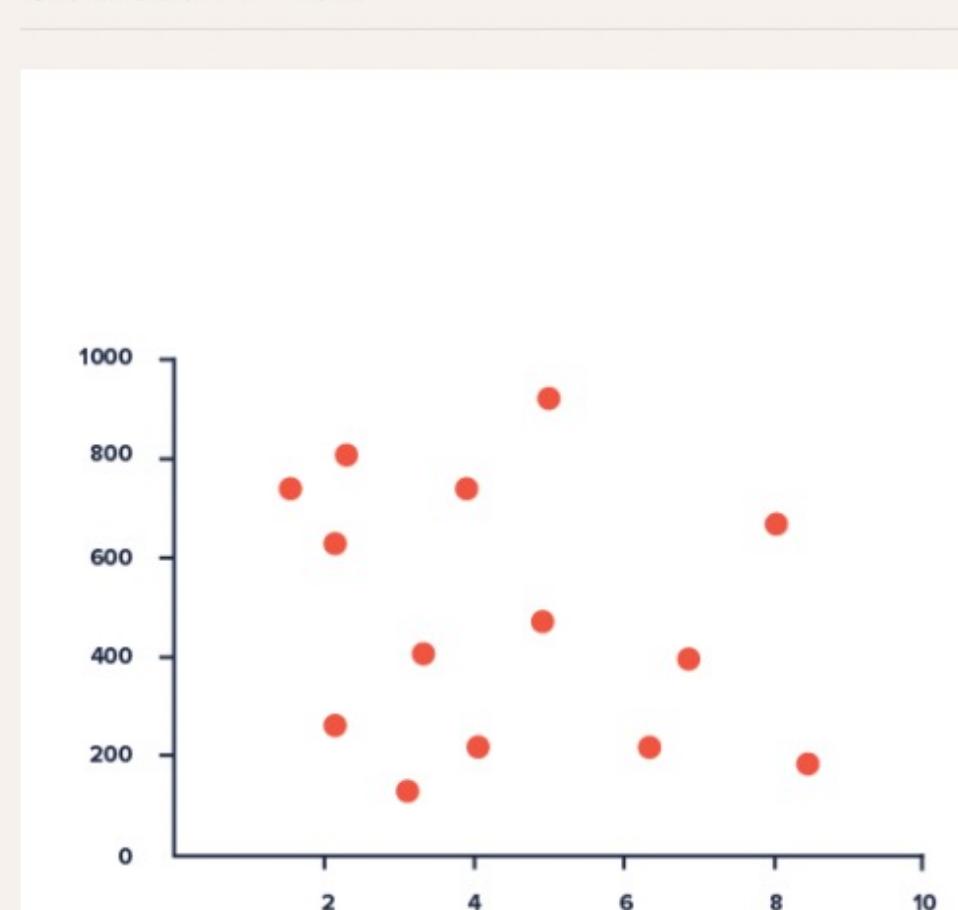
Grouped Bar Chart



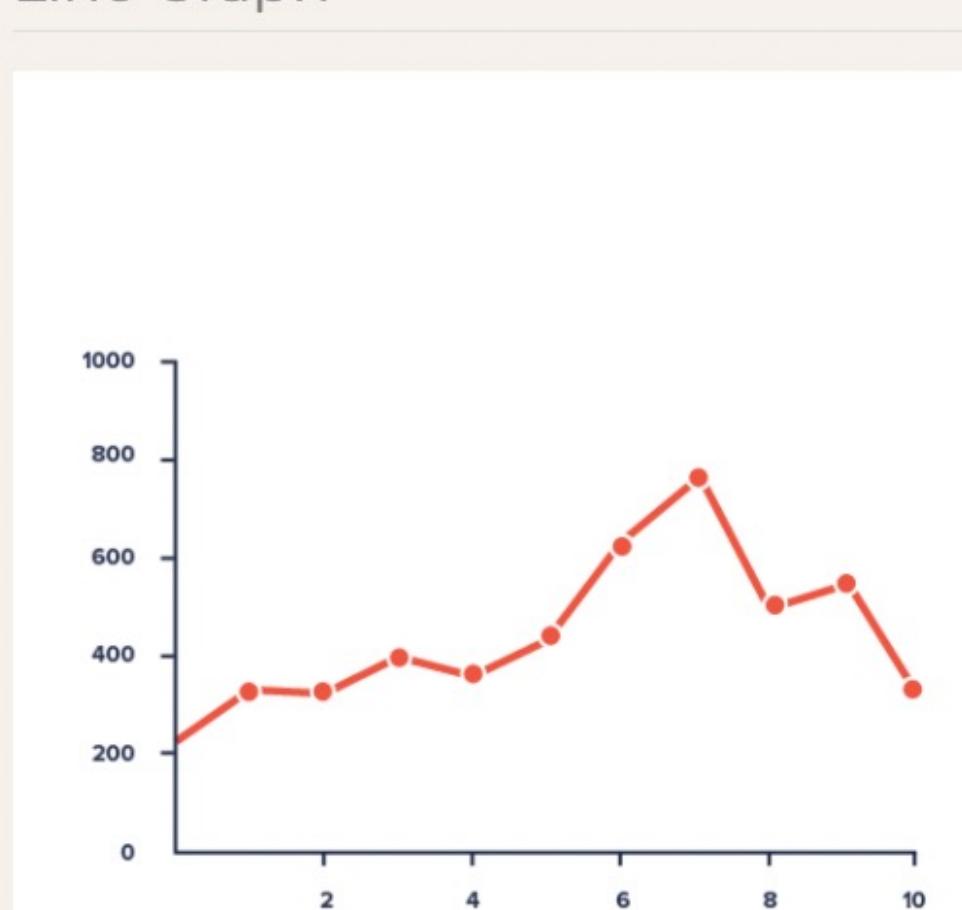
Pie Chart



Scatter Plot

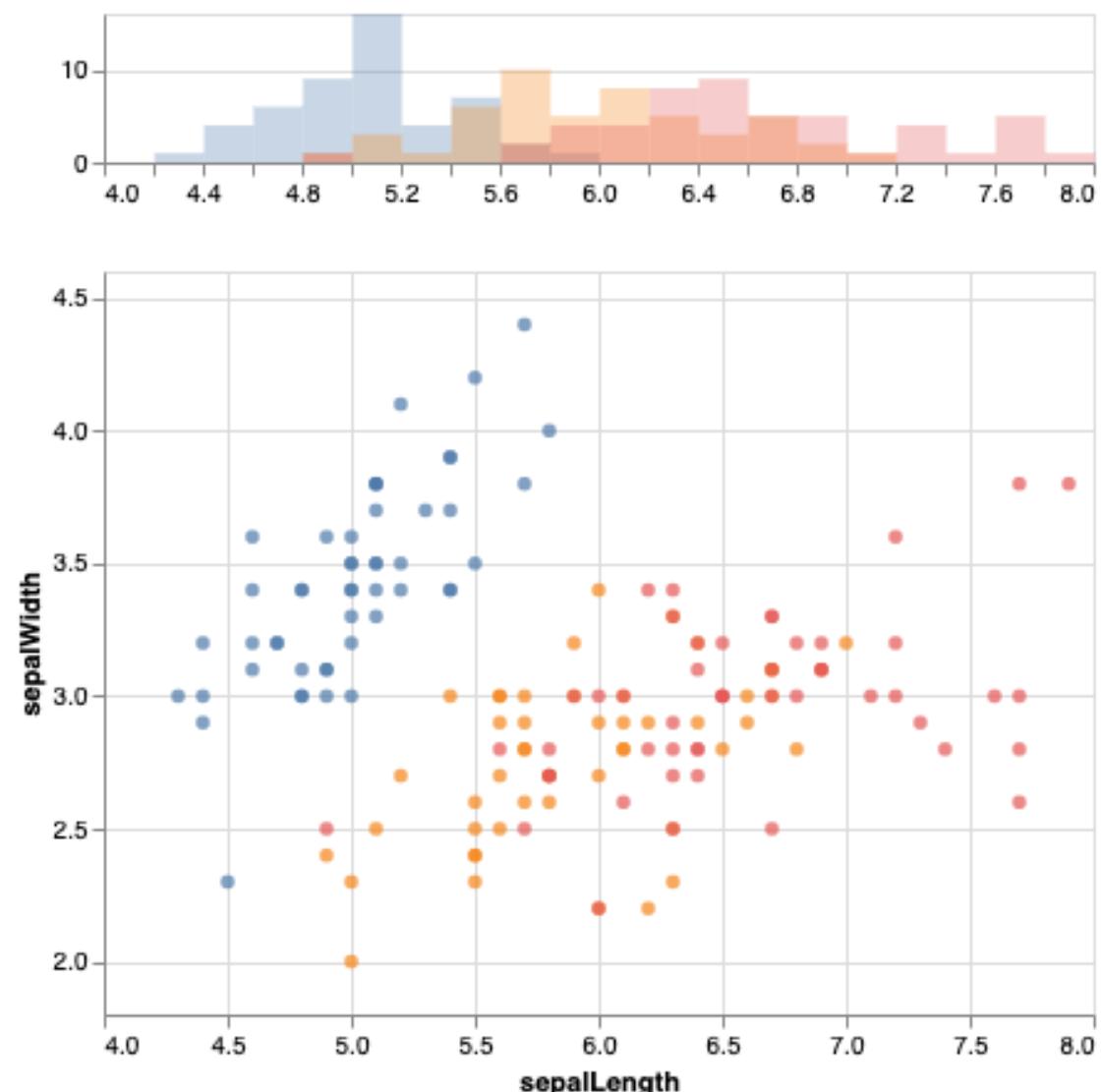


Line Graph

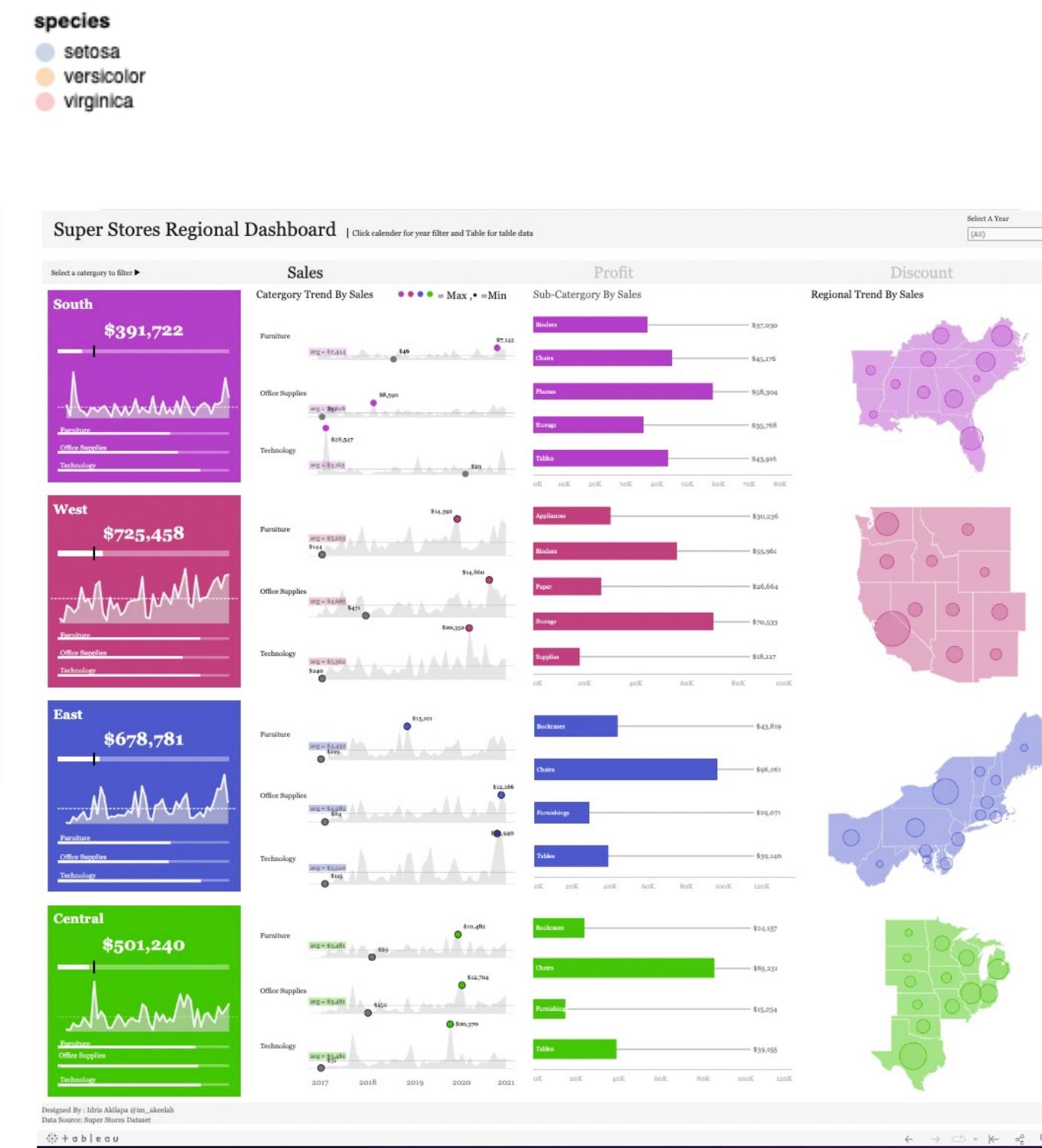


Visual Encoding

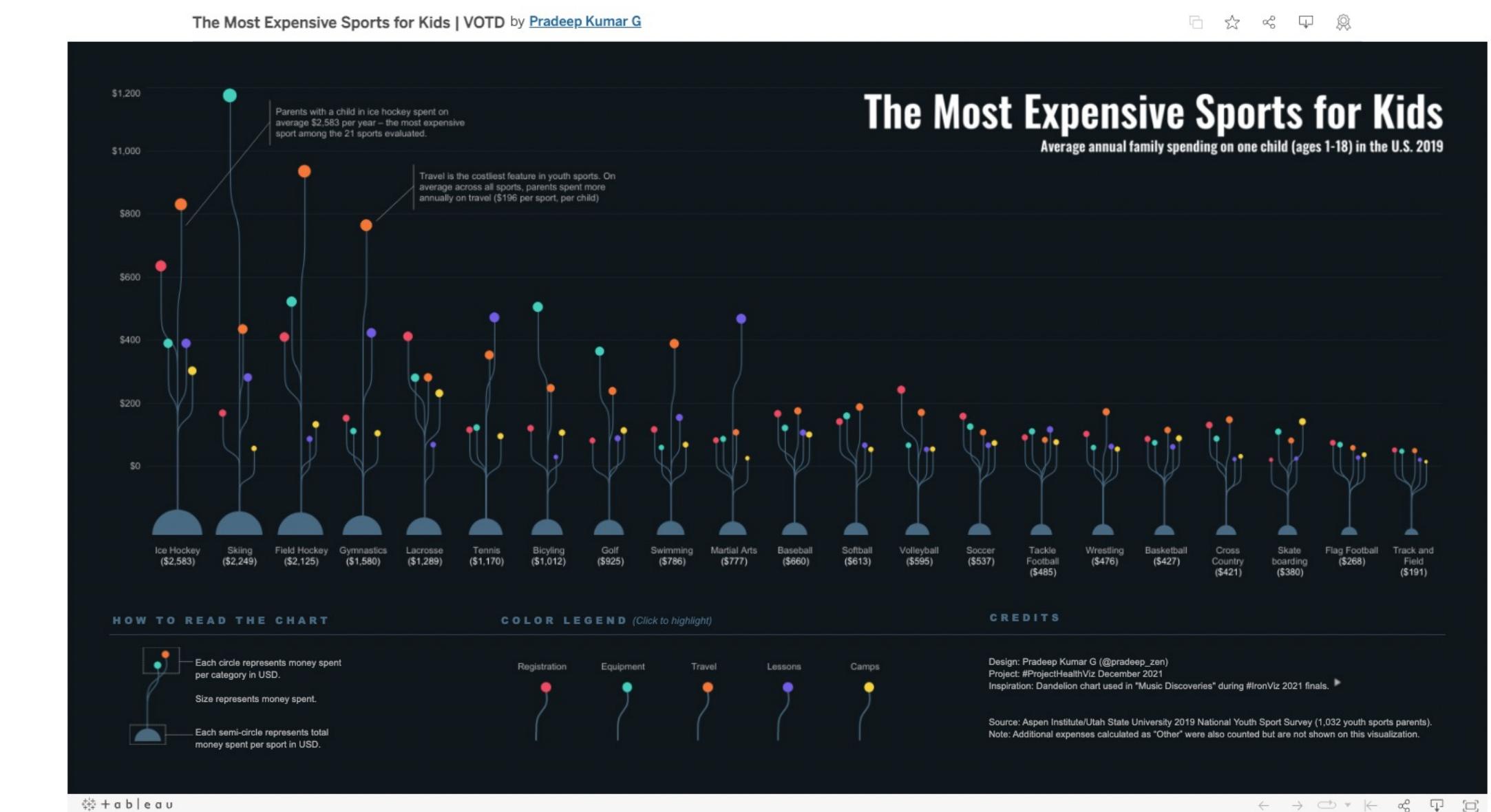
What is it? The literal representation of data in a visualization.



<https://altair-viz.github.io/gallery/index.html>



<https://public.tableau.com/app/profile/akilapa.idris5302/viz/SuperStoresRegionalDashboard/SuperStoreRegionalDashboard>



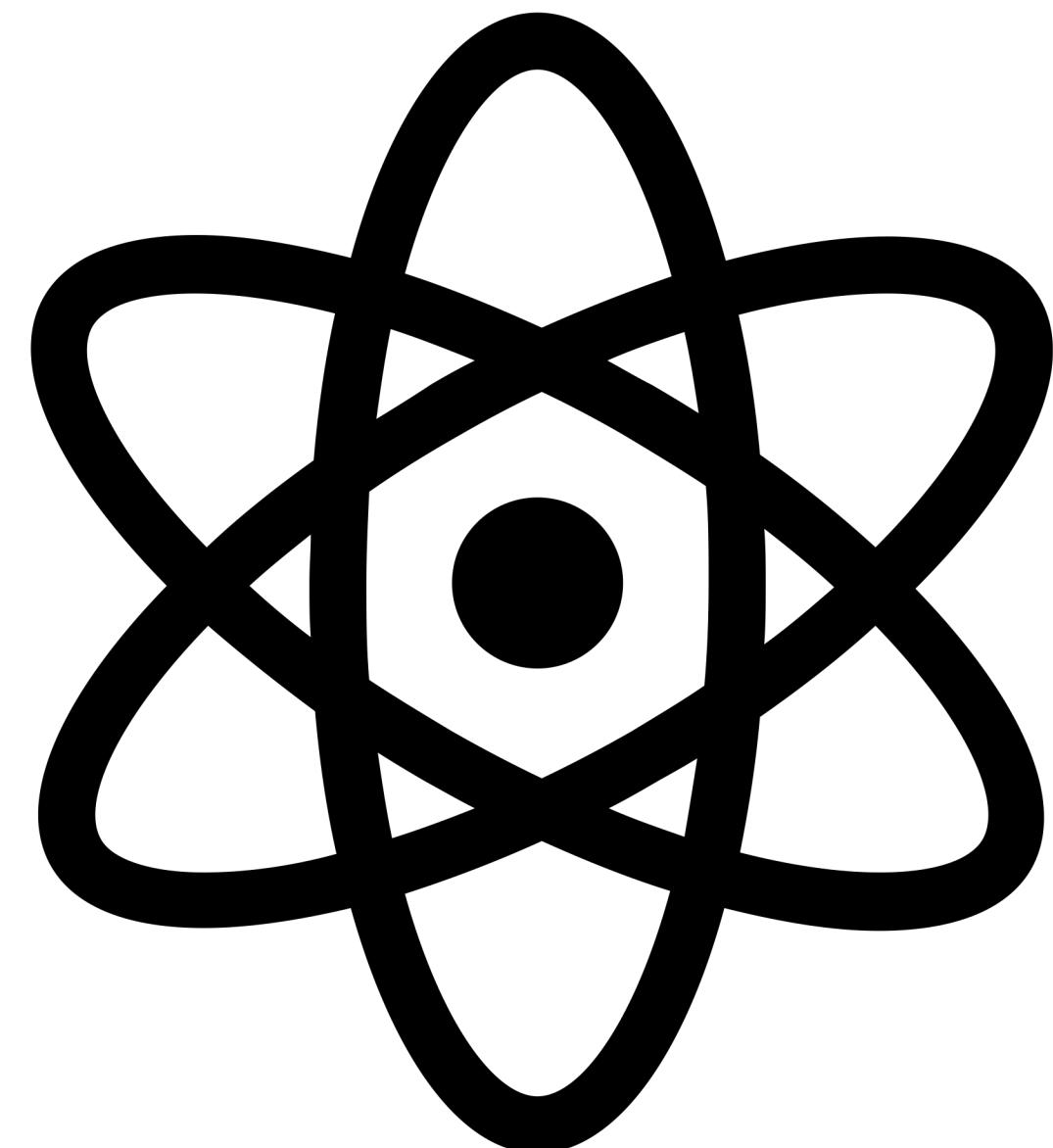
<https://public.tableau.com/app/profile/pradeepkumar.g/viz/TheMostExpensiveSportsforKids/ProjectHealthViz>

Marks and Channels

MARKS AND CHANNELS = basic visual primitives that make up visualizations

MARK = basic graphical element in an image

CHANNELS = ways to control the appearance of marks

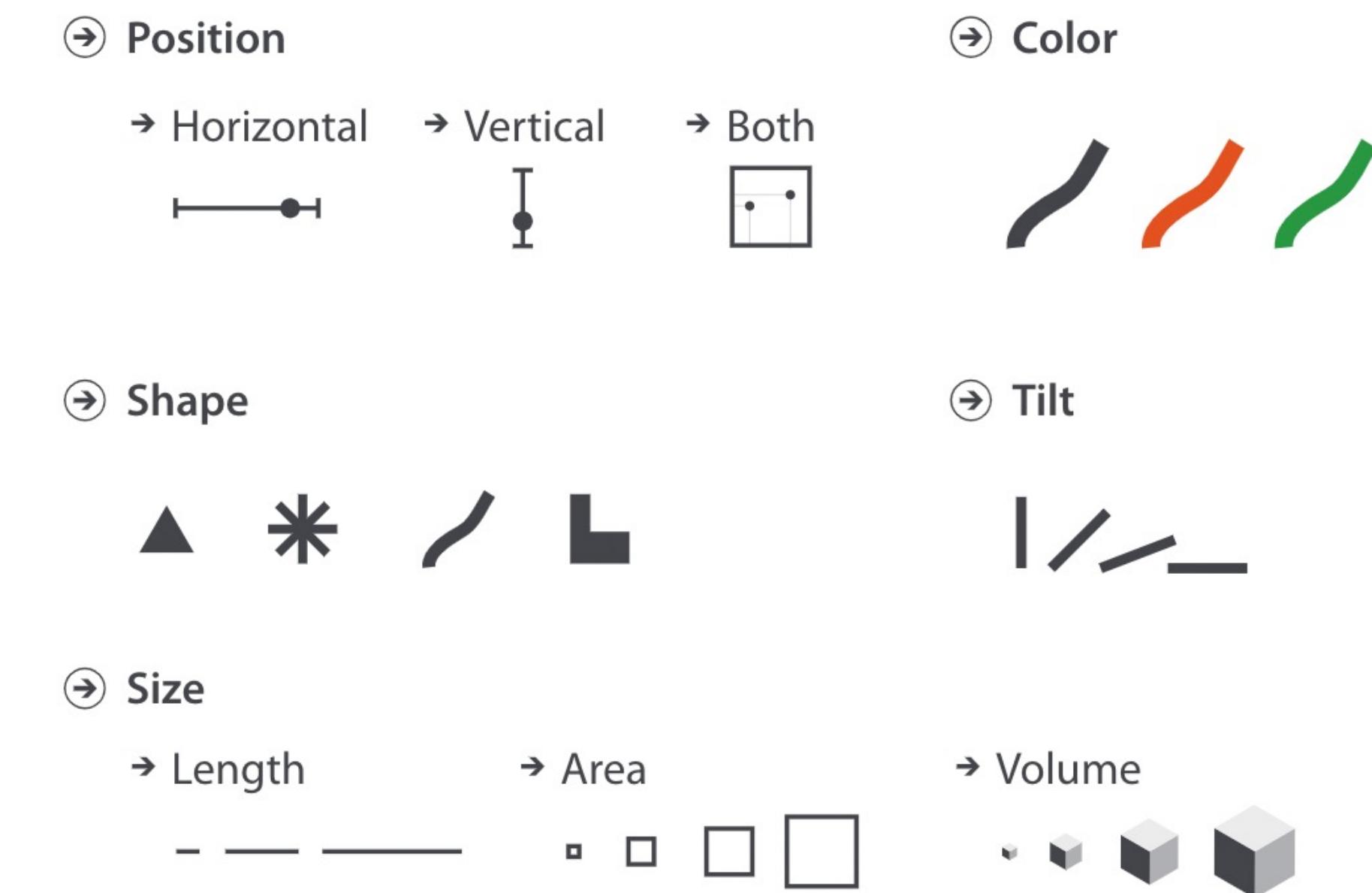


Visual Encoding

MARKS



CHANNELS



Visual Encoding

MARKS

→ Points



→ Lines

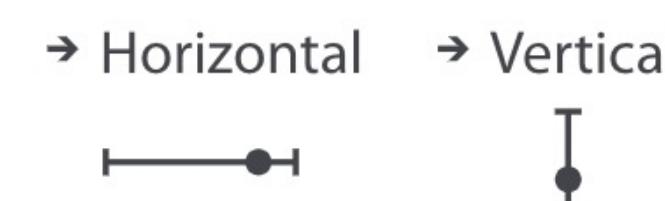


→ Areas



CHANNELS

→ Position



→ Color



→ Tilt



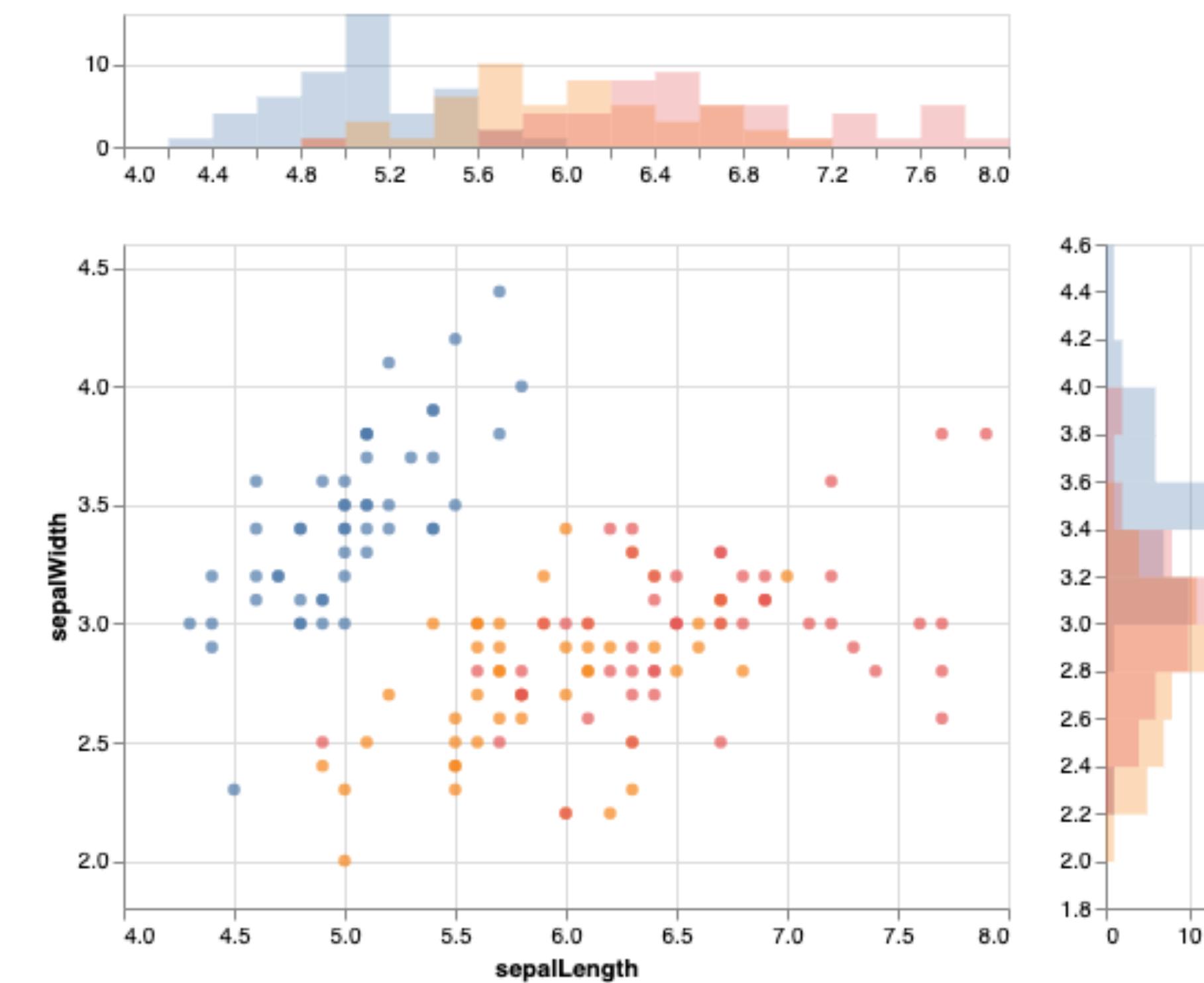
→ Shape



→ Volume



What are the marks and channels in this vis?



Visual Encoding

| DAY_OF_WEEK | TAIL_NUM | ORIGIN | DEST | DEP_TIME | ARR_TIME | CANCELLED | DIVERTED | DISTANCE |
|-------------|----------|--------|------|----------|----------|-----------|----------|----------|
| 1 | N8970D | ATL | CSG | 1640 | 1712 | 0 | 0 | 83 |
| 1 | N8970D | CSG | ATL | 1743 | 1831 | 0 | 0 | 83 |
| 2 | N8688C | GNV | ATL | 601 | 722 | 0 | 0 | 300 |
| 2 | N348PQ | MSP | CVG | 1359 | 1633 | 0 | 0 | 596 |
| 2 | N8896A | DTW | CVG | 1215 | 1329 | 0 | 0 | 229 |
| 4 | N202SY | DEN | OKC | 2012 | 1135 | 0 | 1 | 495 |
| 4 | N134SY | ORD | OKC | 1928 | 1026 | 0 | 1 | 693 |

What are the items, attributes, and attribute types in this dataset?

Visual Encoding

Items:

- row (flight)

Attributes:

- columns

| DAY_OF_WEEK | TAIL_NUM | ORIGIN | DEST | DEP_TIME | ARR_TIME | CANCELLED | DIVERTED | DISTANCE |
|-------------|----------|--------|------|----------|----------|-----------|----------|----------|
| 1 | N8970D | ATL | CSG | 1640 | 1712 | 0 | 0 | 83 |
| 1 | N8970D | CSG | ATL | 1743 | 1831 | 0 | 0 | 83 |
| 2 | N8688C | GNV | ATL | 601 | 722 | 0 | 0 | 300 |
| 2 | N348PQ | MSP | CVG | 1359 | 1633 | 0 | 0 | 596 |
| 2 | N8896A | DTW | CVG | 1215 | 1329 | 0 | 0 | 229 |
| 4 | N202SY | DEN | OKC | 2012 | 1135 | 0 | 1 | 495 |
| 4 | N134SY | ORD | OKC | 1928 | 1026 | 0 | 1 | 693 |

ordinal

categorical

categorical

ordinal

ordinal

categorical

categorical

quantitative

Visual Encoding

Items:

- row (flight)

Attributes:

- columns

| DAY_OF_WEEK | TAIL_NUM | ORIGIN | DEST | DEP_TIME | ARR_TIME | CANCELLED | DIVERTED | DISTANCE |
|-------------|----------|--------|------|----------|----------|-----------|----------|----------|
| 1 | N8970D | ATL | CSG | 1640 | 1712 | 0 | 0 | 83 |
| 1 | N8970D | CSG | ATL | 1743 | 1831 | 0 | 0 | 83 |
| 2 | N8688C | GNV | ATL | 601 | 722 | 0 | 0 | 300 |
| 2 | N348PQ | MSP | CVG | 1359 | 1633 | 0 | 0 | 596 |
| 2 | N8896A | DTW | CVG | 1215 | 1329 | 0 | 0 | 229 |
| 4 | N202SY | DEN | OKC | 2012 | 1135 | 0 | 1 | 495 |
| 4 | N134SY | ORD | OKC | 1928 | 1026 | 0 | 1 | 693 |

ordinal categorical categorical categorical ordinal ordinal categorical categorical quantitative

Sketch a visual encoding that allows the user to check for a relationship between DAY_OF_WEEK and DISTANCE for these flights. Secondarily, your visual encoding should show the DEST and DIVERTED status of each flight.

Visual Encoding

| DAY_OF_WEEK | TAIL_NUM | ORIGIN | DEST | DEP_TIME | ARR_TIME | CANCELLED | DIVERTED | DISTANCE |
|-------------|----------|--------|------|----------|----------|-----------|----------|----------|
| 1 | N8970D | ATL | CSG | 1640 | 1712 | 0 | 0 | 83 |
| 1 | N8970D | CSG | ATL | 1743 | 1831 | 0 | 0 | 83 |
| 2 | N8688C | GNV | ATL | 601 | 722 | 0 | 0 | 300 |
| 2 | N348PQ | MSP | CVG | 1359 | 1633 | 0 | 0 | 596 |
| 2 | N8896A | DTW | CVG | 1215 | 1329 | 0 | 0 | 229 |
| 4 | N202SY | DEN | OKC | 2012 | 1135 | 0 | 1 | 495 |
| 4 | N134SY | ORD | OKC | 1928 | 1026 | 0 | 1 | 693 |

MARKS:

- points (item)

CHANNELS:

- DAY_OF_WEEK → horizontal position
- DISTANCE → vertical position
- DEST → shape
- DIVERTED → color

Visual Encoding

| DAY_OF_WEEK | TAIL_NUM | ORIGIN | DEST | DEP_TIME | ARR_TIME | CANCELLED | DIVERTED | DISTANCE |
|-------------|----------|--------|------|----------|----------|-----------|----------|----------|
| 1 | N8970D | ATL | CSG | 1640 | 1712 | 0 | 0 | 83 |
| 1 | N8970D | CSG | ATL | 1743 | 1831 | 0 | 0 | 83 |
| 2 | N8688C | GNV | ATL | 601 | 722 | 0 | 0 | 300 |
| 2 | N348PQ | MSP | CVG | 1359 | 1633 | 0 | 0 | 596 |
| 2 | N8896A | DTW | CVG | 1215 | 1329 | 0 | 0 | 229 |
| 4 | N202SY | DEN | OKC | 2012 | 1135 | 0 | 1 | 495 |
| 4 | N134SY | ORD | OKC | 1928 | 1026 | 0 | 1 | 693 |

MARKS:

- points (item)

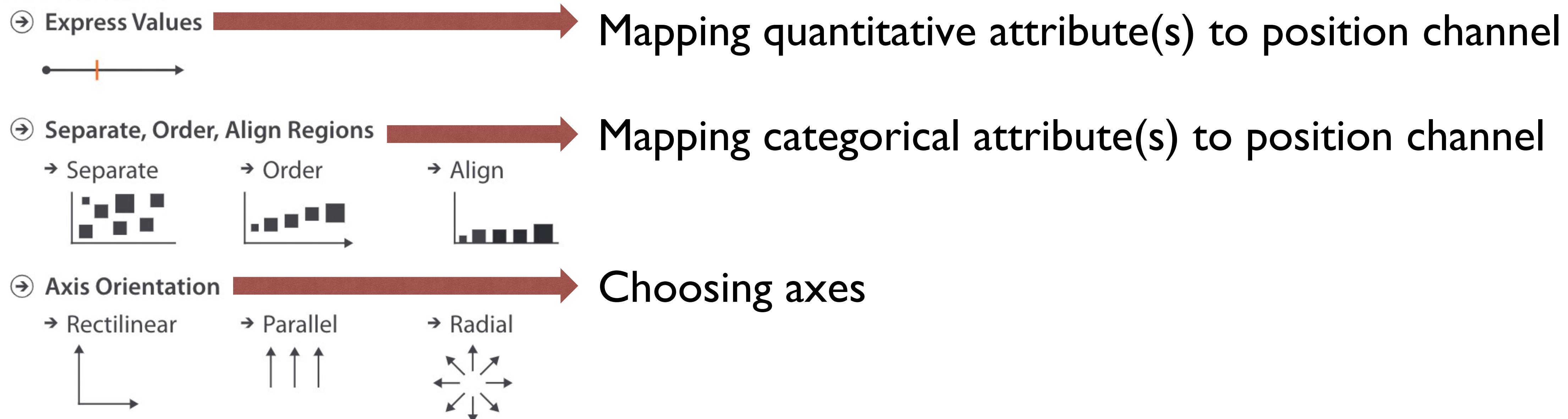
CHANNELS:

- DAY_OF_WEEK → horizontal position
- DISTANCE → vertical position
- DEST → shape
- DIVERTED → color



Arrange (tables)

ARRANGE (HOW WILL WE USE OUR MOST EFFECTIVE CHANNELS?)



Arrange (tables)

ARRANGE

Express Values



Separate, Order, Align Regions

→ Separate



→ Order



→ Align



Axis Orientation

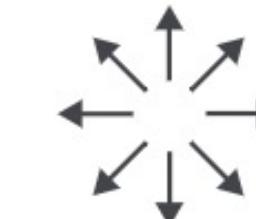
→ Rectilinear



→ Parallel



→ Radial



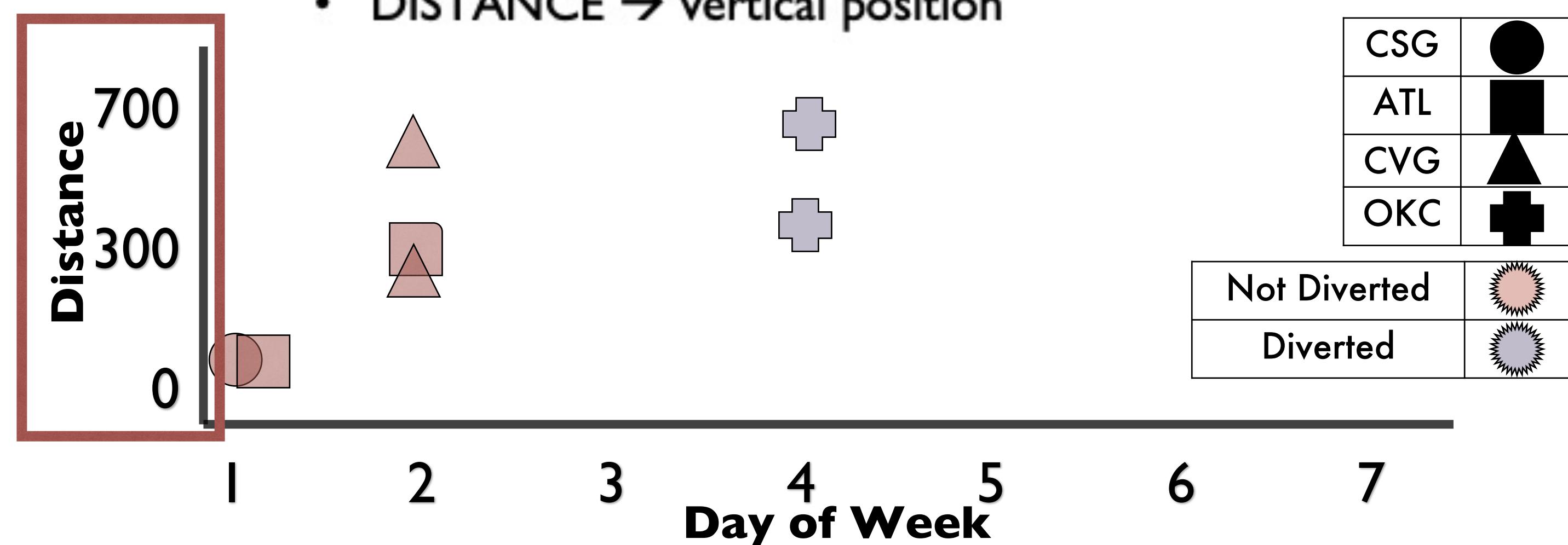
| DAY_OF_WEEK | TAIL_NUM | ORIGIN | DEST | DEP_TIME | ARR_TIME | CANCELLED | DIVERTED | DISTANCE |
|-------------|----------|--------|------|----------|----------|-----------|----------|----------|
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| 4 | N134SY | ORD | OKC | 1928 | 1026 | 0 | 1 | 693 |

MARKS:

- points (item)

CHANNELS:

- DAY_OF_WEEK → horizontal position
- DEST → shape
- DIVERTED → color
- DISTANCE → vertical position



Arrange (tables)

ARRANGE

Express Values



Separate, Order, Align Regions

→ Separate



→ Order

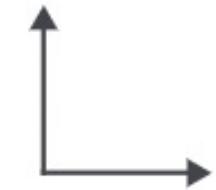


→ Align



Axis Orientation

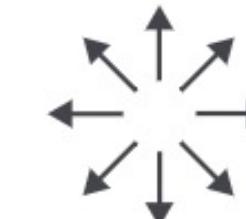
→ Rectilinear



→ Parallel



→ Radial



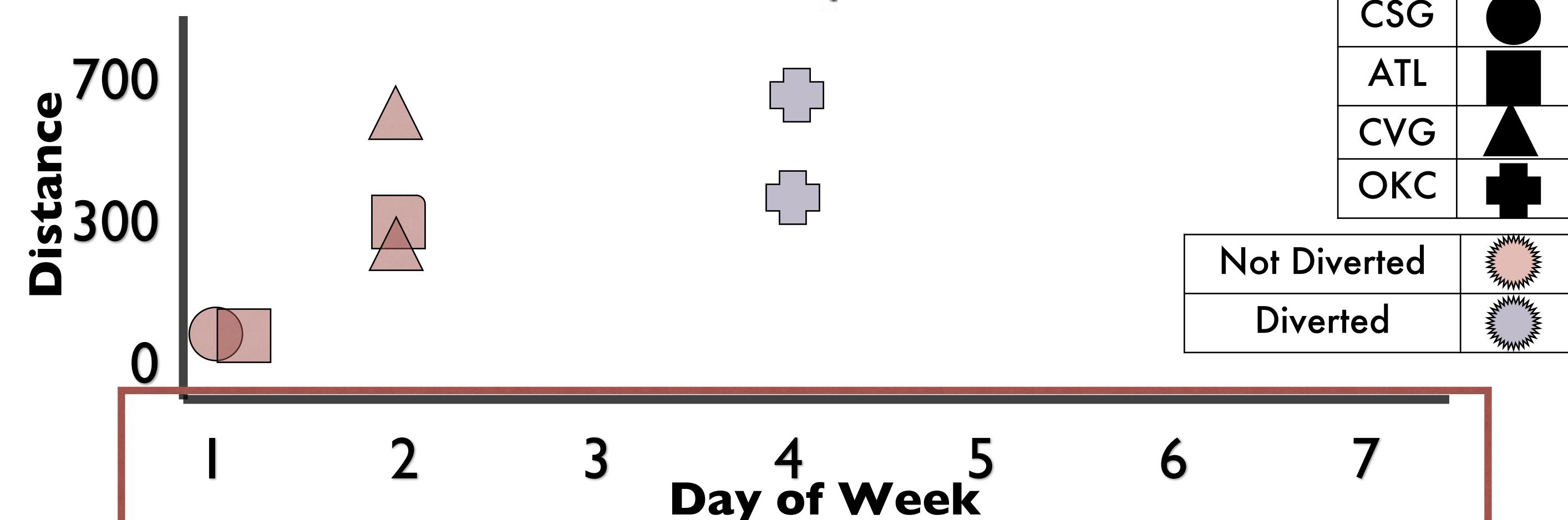
| DAY_OF_WEEK | TAIL_NUM | ORIGIN | DEST | DEP_TIME | ARR_TIME | CANCELLED | DIVERTED | DISTANCE |
|-------------|----------|--------|------|----------|----------|-----------|----------|----------|
| 1 | N8970D | ATL | CSG | 1640 | 1712 | 0 | 0 | 83 |
| 1 | N8970D | CSG | ATL | 1743 | 1831 | 0 | 0 | 83 |
| 2 | N8688C | GNV | ATL | 601 | 722 | 0 | 0 | 300 |
| 2 | N348PQ | MSP | CVG | 1359 | 1633 | 0 | 0 | 596 |
| 2 | N8896A | DTW | CVG | 1215 | 1329 | 0 | 0 | 229 |
| 4 | N202SY | DEN | OKC | 2012 | 1135 | 0 | 1 | 495 |
| 4 | N134SY | ORD | OKC | 1928 | 1026 | 0 | 1 | 693 |

MARKS:

- points (item)

CHANNELS:

- DAY_OF_WEEK → horizontal position
- DEST → shape
- DIVERTED → color
- DISTANCE → vertical position



Arrange (tables)

ARRANGE

Express Values



Separate, Order, Align Regions

→ Separate



→ Order

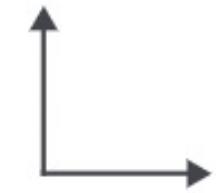


→ Align



Axis Orientation

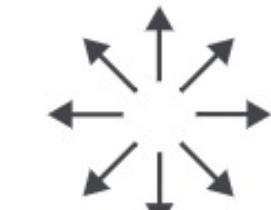
→ Rectilinear



→ Parallel



→ Radial

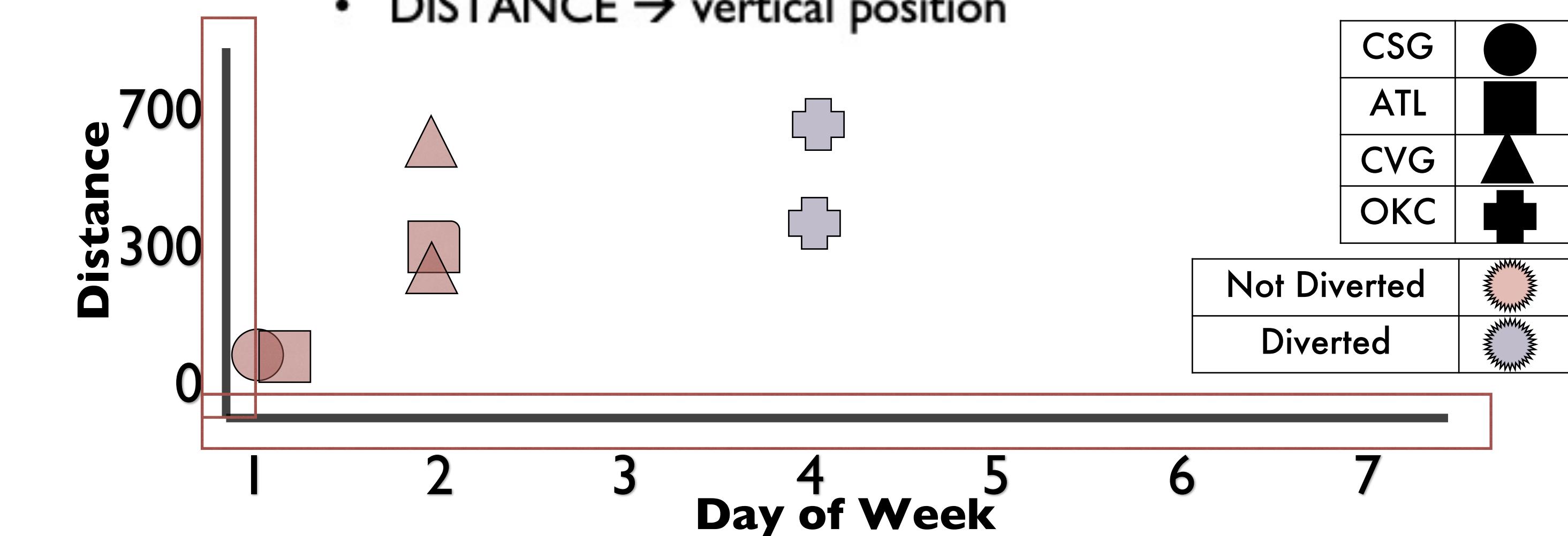


MARKS:

- points (item)

CHANNELS:

- DAY_OF_WEEK → horizontal position
- DEST → shape
- DIVERTED → color
- DISTANCE → vertical position



Arrange (tables)

ARRANGE

④ Express Values



④ Separate, Order, Align Regions

→ Separate



→ Order



→ Align



④ Axis Orientation

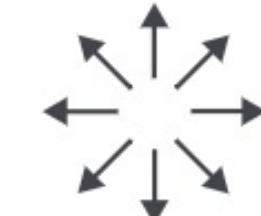
→ Rectilinear



→ Parallel



→ Radial



Considerations for the arrange step:

Arrange (tables)

ARRANGE

④ Express Values

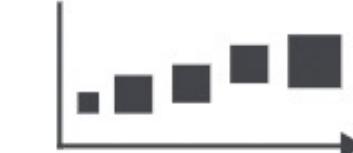


④ Separate, Order, Align Regions

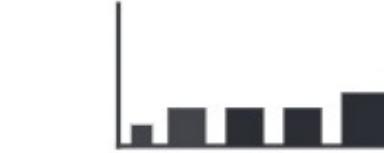
→ Separate



→ Order

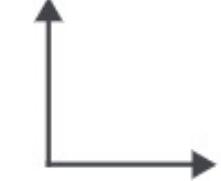


→ Align

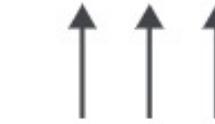


④ Axis Orientation

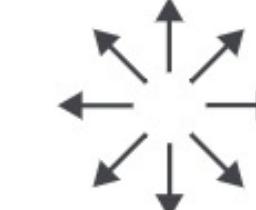
→ Rectilinear



→ Parallel



→ Radial



Considerations for the arrange step:

For tables, we arrange items by keys and values:

Key = an independent attribute(s) that can be used as a ***unique index*** to look up table items
→ Categorical or ordinal

Value = a dependent attribute, value in a specific cell

Arrange (tables)

ARRANGE

④ Express Values



④ Separate, Order, Align Regions

→ Separate



→ Order



→ Align



④ Axis Orientation

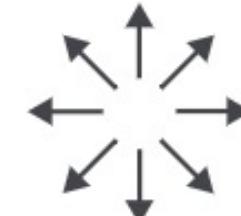
→ Rectilinear



→ Parallel



→ Radial



Considerations for the arrange step:

For tables, we arrange items by keys and values:

Key = an independent attribute(s) that can be used as a ***unique index*** to look up table items
→ Categorical or ordinal

Value = a dependent attribute, value in a specific cell

Arrange (tables)

Sketch a vis that supports the following task:

- Compare start time of each street sweeping zone

| MainID | St_name | Dist | DistName | StartTime | EndTime | Side | from | to | miles | oneway | week1 |
|--------|--------------|------|------------------|-----------|---------|------|---------------|----------------|--------|--------|-------|
| 1 | Ackley Pl | 2 | Jamaica Plain | 08:00 | 12:00 | Even | Washington St | Dead End | 0.0455 | FALSE | FALSE |
| 2 | Arcadia Park | 3 | North Dorchester | 08:00 | 12:00 | Even | Draper St | Ditson St | 0.0835 | FALSE | FALSE |
| 3 | Ashcroft St | 2 | Jamaica Plain | 08:00 | 12:00 | Odd | Perkins St | Moraine St | 0.1015 | FALSE | TRUE |
| 4 | Boylston St | 1B | Back Bay | 00:01 | 07:00 | | Tremont St | Charles St | 0.1519 | FALSE | TRUE |
| 5 | Chestnut St | 1H | Beacon Hill | 08:00 | 12:00 | Even | Walnut St | Charles St | 0.2008 | FALSE | FALSE |
| 6 | Blackwood St | 1B | Back Bay | 08:00 | 12:00 | Even | St Botolph St | Dead End | 0.0517 | FALSE | FALSE |
| 7 | Bucknam St | 10M | Mission Hill | 12:00 | 16:00 | Odd | Lawn St | Fisher Ave | 0.0803 | FALSE | TRUE |
| 8 | Acadia St | 5 | South Boston | 09:00 | 13:00 | Even | East First St | East Second St | 0.0568 | FALSE | TRUE |
| 9 | Acadia St | 5 | South Boston | 09:00 | 13:00 | Odd | East First St | East Second St | 0.0568 | FALSE | FALSE |
| 10 | Allston St | 7 | South Dorchester | 12:00 | 16:00 | Odd | Centre St | Melville Ave | 0.1955 | FALSE | TRUE |

Arrange (tables)

Sketch a vis that supports the following task:

- Compare **start time** of each **street sweeping zone**

Value

Key

Key

Value

| MainID | St_name | Dist | DistName | StartTime | EndTime | Side | from | to | miles | oneway | week1 |
|--------|--------------|------|------------------|-----------|---------|------|---------------|----------------|--------|--------|-------|
| 1 | Ackley Pl | 2 | Jamaica Plain | 08:00 | 12:00 | Even | Washington St | Dead End | 0.0455 | FALSE | FALSE |
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| 7 | Bucknam St | 10M | Mission Hill | 12:00 | 16:00 | Odd | Lawn St | Fisher Ave | 0.0803 | FALSE | TRUE |
| 8 | Acadia St | 5 | South Boston | 09:00 | 13:00 | Even | East First St | East Second St | 0.0568 | FALSE | TRUE |
| 9 | Acadia St | 5 | South Boston | 09:00 | 13:00 | Odd | East First St | East Second St | 0.0568 | FALSE | FALSE |
| 10 | Allston St | 7 | South Dorchester | 12:00 | 16:00 | Odd | Centre St | Melville Ave | 0.1955 | FALSE | TRUE |

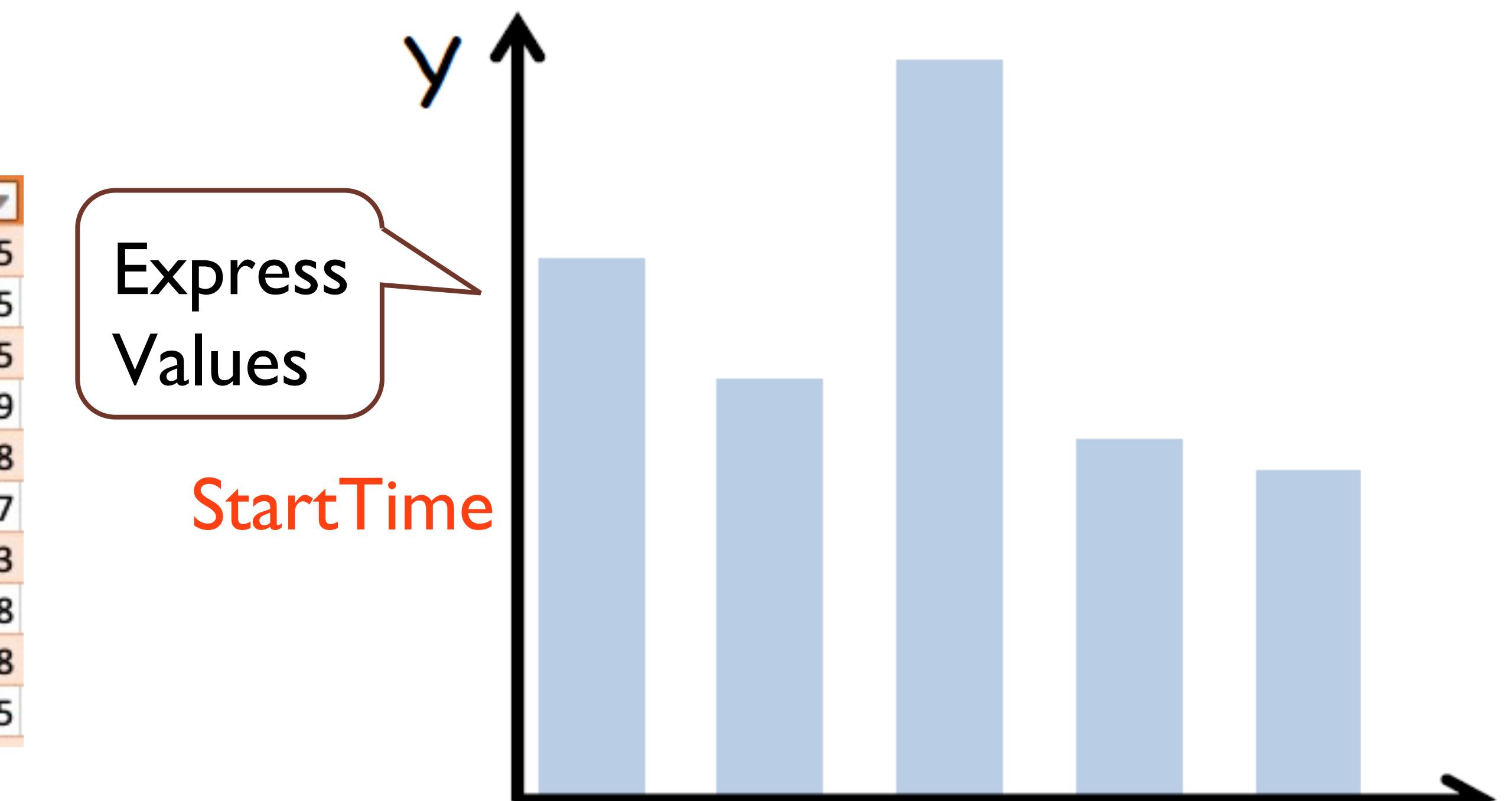
Arrange (tables)

One key (list alignment)

Key

| MainID | St_name | Dist | DistName | StartTime | miles |
|--------|--------------|------|------------------|-----------|--------|
| 1 | Ackley Pl | 2 | Jamaica Plain | 08:00 | 0.0455 |
| 2 | Arcadia Park | 3 | North Dorchester | 08:00 | 0.0835 |
| 3 | Ashcroft St | 2 | Jamaica Plain | 08:00 | 0.1015 |
| 4 | Boylston St | 1B | Back Bay | 00:01 | 0.1519 |
| 5 | Chestnut St | 1H | Beacon Hill | 08:00 | 0.2008 |
| 6 | Blackwood St | 1B | Back Bay | 08:00 | 0.0517 |
| 7 | Bucknam St | 10M | Mission Hill | 12:00 | 0.0803 |
| 8 | Acadia St | 5 | South Boston | 09:00 | 0.0568 |
| 9 | Acadia St | 5 | South Boston | 09:00 | 0.0568 |
| 10 | Allston St | 7 | South Dorchester | 12:00 | 0.1955 |

Value



Express
Values

StartTime

Separate, order,
align (by key)

BAR CHART

Arrange (tables)

Sketch a vis that supports the following task:

- Compare number of students for each major and college

| College ▾ | Major ▾ | Num Students ▾ |
|---------------|------------------|----------------|
| Khoury | Computer Science | 300 |
| | Data Science | 475 |
| | Math | 699 |
| COS | Math | 80 |
| | Data Science | 402 |
| D'Amore-McKim | Computer Science | 337 |
| | Data Science | 920 |

Arrange (tables)

Sketch a vis that supports the following task:

- Compare **number of students** for each **major and college**

Value

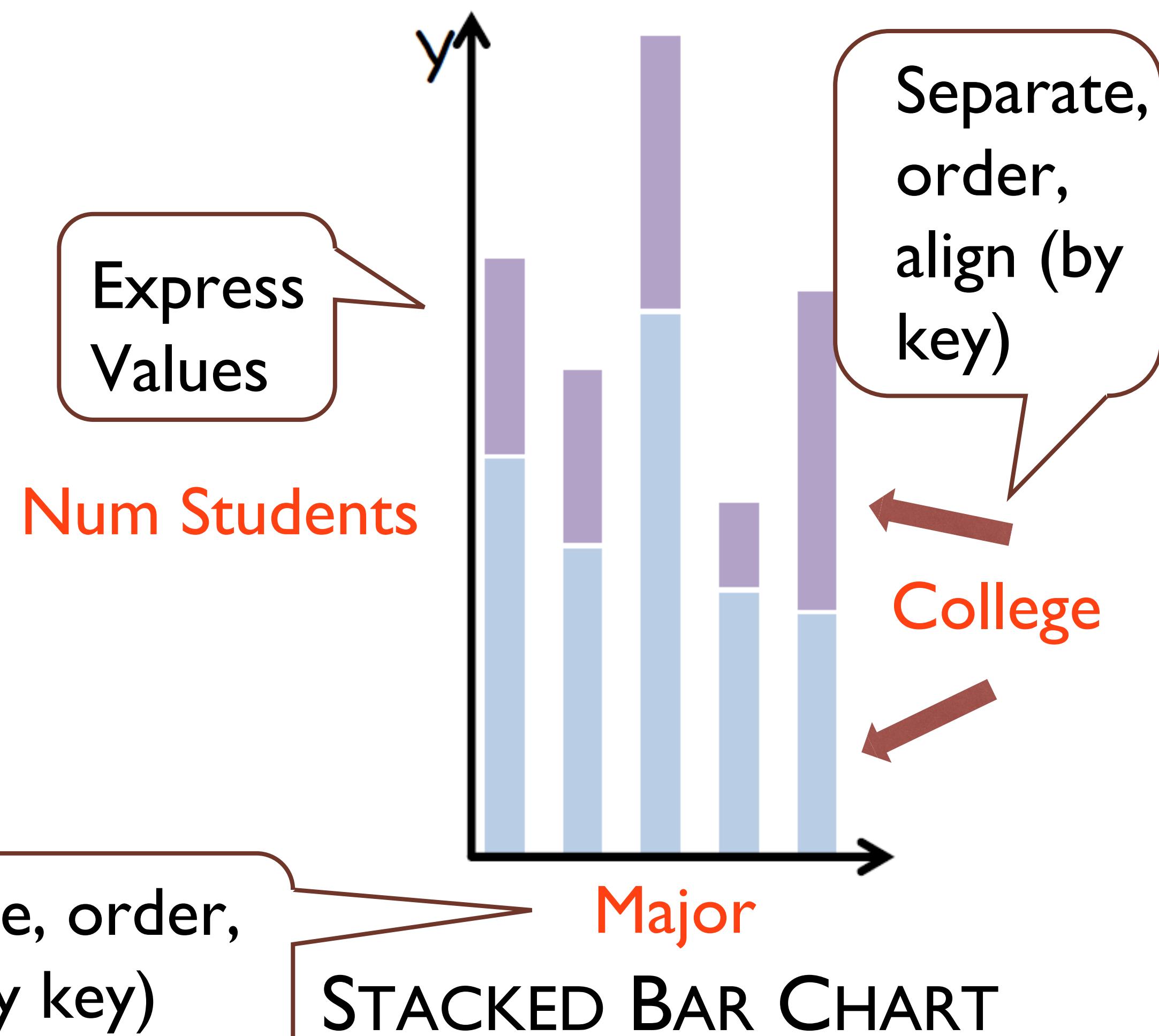
2 Keys

| Key | Key | Value |
|---------------|------------------|--------------|
| College | Major | Num Students |
| Khoury | Computer Science | 300 |
| Khoury | Data Science | 475 |
| Khoury | Math | 699 |
| COS | Math | 80 |
| COS | Data Science | 402 |
| D'Amore-McKim | Computer Science | 337 |
| D'Amore-McKim | Data Science | 920 |

Arrange (tables)

Two keys (multi-dimensional table)

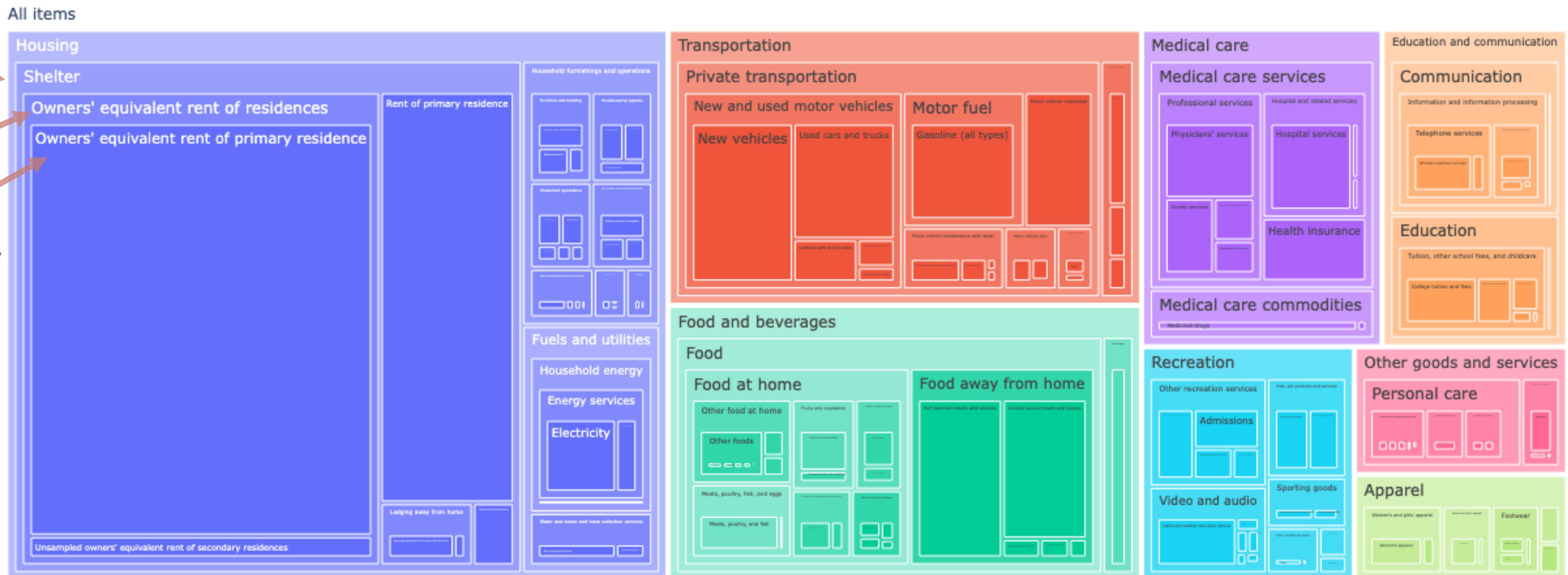
| Key | Key | Value |
|---------|------------------|--------------|
| College | Major | Num Students |
| Khoury | Computer Science | 300 |
| Khoury | Data Science | 475 |
| Khoury | Math | 699 |
| COS | Math | 80 |
| COS | Data Science | 402 |



Arrange (tables)

Note: we can also have more than two keys

Key
Key
Key
Key



Separate,
order,
align (by
key)

Arrange (tables)

Sketch a vis that supports the following task:

- Look for a relationship between air date and question value

| Show Number | Air Date | Round | Category | Value | Question | Answer |
|-------------|----------|------------------|----------------|---------|---|-----------------|
| 4742 | 3/29/05 | Double Jeopardy! | FOUND IN SPACE | \$2,000 | 9-letter word for the phenomenon that produced the mass of stellar debris called Cassiopeia A | a supernova |
| 4742 | 3/29/05 | Double Jeopardy! | FOUND IN SPACE | \$800 | A.C. Crommelin proved that 3 of these, seen in 1818, 1873 & 1928, were really 1 of these visiting 3 times | comets |
| 4742 | 3/29/05 | Double Jeopardy! | FOUND IN SPACE | \$1,600 | The radiant is the point from which these, such as the Lyrids, originate | meteor showers |
| 3699 | 10/5/00 | Double Jeopardy! | FRACTIONS | \$200 | An improper fraction is rude enough to have a numerator greater than or equal to this | the denominator |
| 3699 | 10/5/00 | Double Jeopardy! | FRACTIONS | \$400 | In its lowest terms, a .400 batting average in baseball is this fraction | 5-Feb |
| 3699 | 10/5/00 | Double Jeopardy! | FRACTIONS | \$1,000 | It's how you express the fraction 7/4 as a mixed number | 1 3/4 |
| 3699 | 10/5/00 | Double Jeopardy! | FRACTIONS | \$600 | It's the decimal form of the fraction 3/1000 | 0.003 |
| 3699 | 10/5/00 | Double Jeopardy! | FRACTIONS | \$800 | To divide a number by 3/4, multiply the number by this fraction | 3-Apr |
| 5333 | 11/14/07 | Jeopardy! | FRENCH MENU | \$1,000 | Ah! A luscious gateau Montmorency, a cake topped with this fruit | cherries |
| 3342 | 3/2/99 | Jeopardy! | FRENCH MENU | \$300 | Bifteck | Steak |
| 3342 | 3/2/99 | Jeopardy! | FRENCH MENU | \$200 | Eau minerale | Mineral water |
| 3342 | 3/2/99 | Jeopardy! | FRENCH MENU | \$100 | Escargots | Snails |

Arrange (tables)

Sketch a vis that supports the following task:

- Look for a relationship between **air date** and question **value**

Value

Value

Value

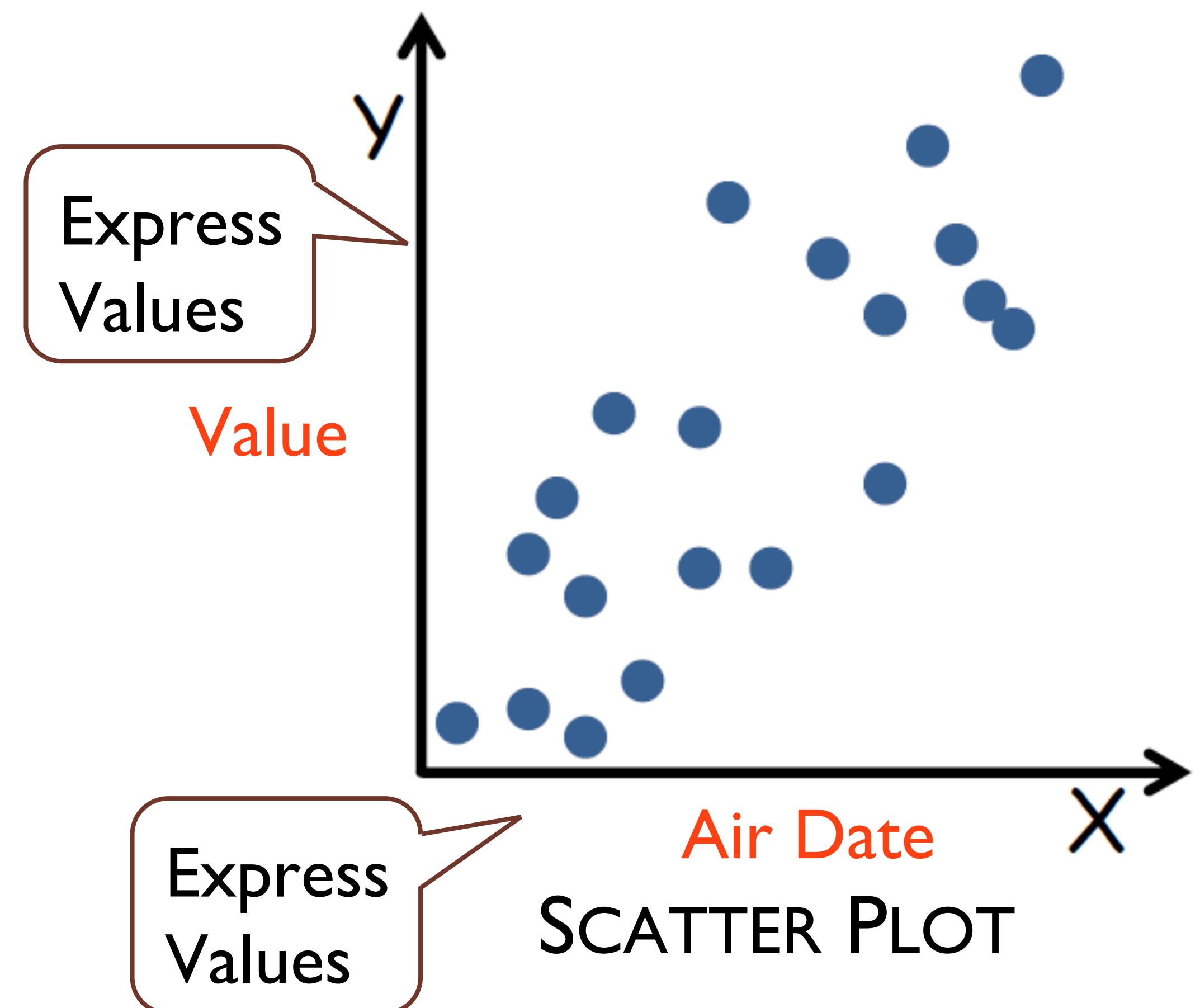
Value

| Show Number | Air Date | Round | Category | Value | Question | Answer |
|-------------|----------|------------------|----------------|---------|---|-----------------|
| 4742 | 3/29/05 | Double Jeopardy! | FOUND IN SPACE | \$2,000 | 9-letter word for the phenomenon that produced the mass of stellar debris called Cassiopeia A | a supernova |
| 4742 | 3/29/05 | Double Jeopardy! | FOUND IN SPACE | \$800 | A.C. Crommelin proved that 3 of these, seen in 1818, 1873 & 1928, were really 1 of these visiting 3 times | comets |
| 4742 | 3/29/05 | Double Jeopardy! | FOUND IN SPACE | \$1,600 | The radiant is the point from which these, such as the Lyrids, originate | meteor showers |
| 3699 | 10/5/00 | Double Jeopardy! | FRACTIONS | \$200 | An improper fraction is rude enough to have a numerator greater than or equal to this | the denominator |
| 3699 | 10/5/00 | Double Jeopardy! | FRACTIONS | \$400 | In its lowest terms, a .400 batting average in baseball is this fraction | 5-Feb |
| 3699 | 10/5/00 | Double Jeopardy! | FRACTIONS | \$1,000 | It's how you express the fraction 7/4 as a mixed number | 1 3/4 |
| 3699 | 10/5/00 | Double Jeopardy! | FRACTIONS | \$600 | It's the decimal form of the fraction 3/1000 | 0.003 |
| 3699 | 10/5/00 | Double Jeopardy! | FRACTIONS | \$800 | To divide a number by 3/4, multiply the number by this fraction | 3-Apr |
| 5333 | 11/14/07 | Jeopardy! | FRENCH MENU | \$1,000 | Ah! A luscious gateau Montmorency, a cake topped with this fruit | cherries |
| 3342 | 3/2/99 | Jeopardy! | FRENCH MENU | \$300 | Bifteck | Steak |
| 3342 | 3/2/99 | Jeopardy! | FRENCH MENU | \$200 | Eau minerale | Mineral water |
| 3342 | 3/2/99 | Jeopardy! | FRENCH MENU | \$100 | Escargots | Snails |

Arrange (tables)

No key

| Value | | | |
|-------------|----------|------------------|----------------|
| Show Number | Air Date | Round | Category |
| 4742 | 3/29/05 | Double Jeopardy! | FOUND IN SPACE |
| 4742 | 3/29/05 | Double Jeopardy! | FOUND IN SPACE |
| 4742 | 3/29/05 | Double Jeopardy! | FOUND IN SPACE |
| 3699 | 10/5/00 | Double Jeopardy! | FRACTIONS |
| 3699 | 10/5/00 | Double Jeopardy! | FRACTIONS |
| 3699 | 10/5/00 | Double Jeopardy! | FRACTIONS |
| 3699 | 10/5/00 | Double Jeopardy! | FRACTIONS |
| 3699 | 10/5/00 | Double Jeopardy! | FRACTIONS |
| 5333 | 11/14/07 | Jeopardy! | FRENCH MENU |
| 3342 | 3/2/99 | Jeopardy! | FRENCH MENU |
| 3342 | 3/2/99 | Jeopardy! | FRENCH MENU |
| 3342 | 3/2/99 | Jeopardy! | FRENCH MENU |



Arrange (tables)

ARRANGE

④ Express Values → Mapping quantitative attribute(s) to position channel

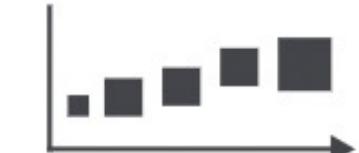


④ Separate, Order, Align Regions → Mapping categorical attribute(s) to position channel

→ Separate



→ Order

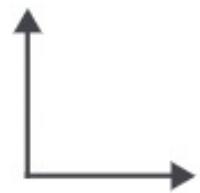


→ Align



④ Axis Orientation

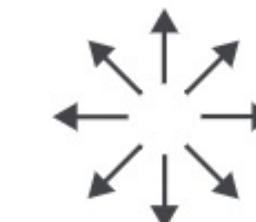
→ Rectilinear



→ Parallel



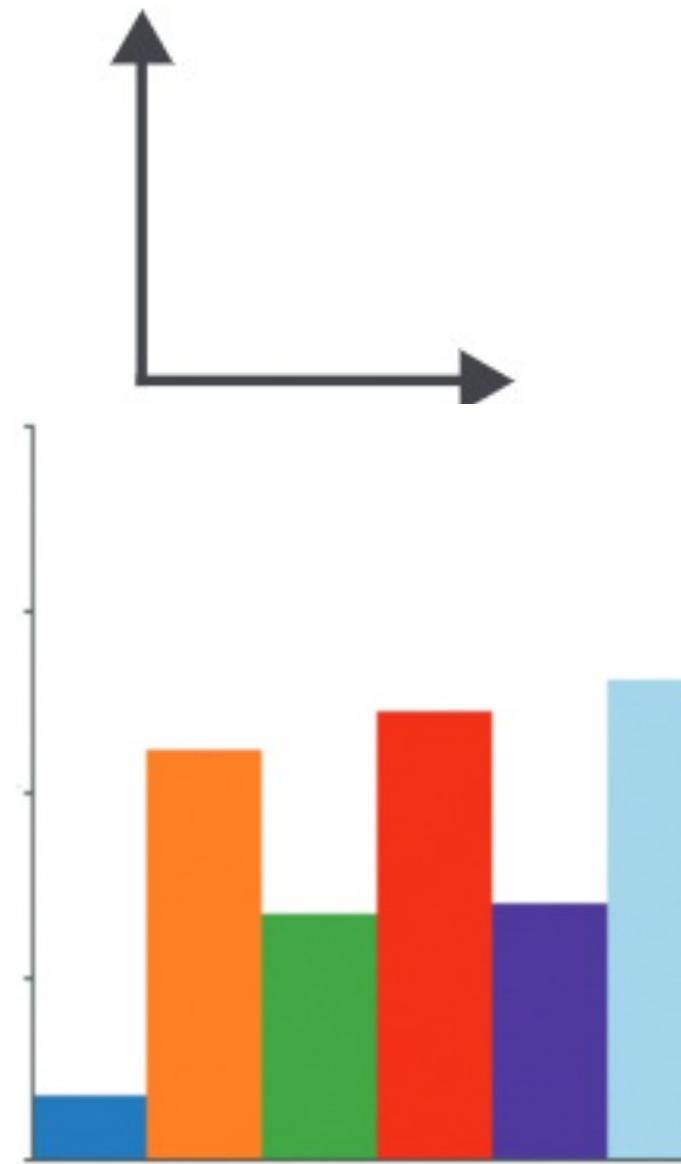
→ Radial



Arrange (tables)

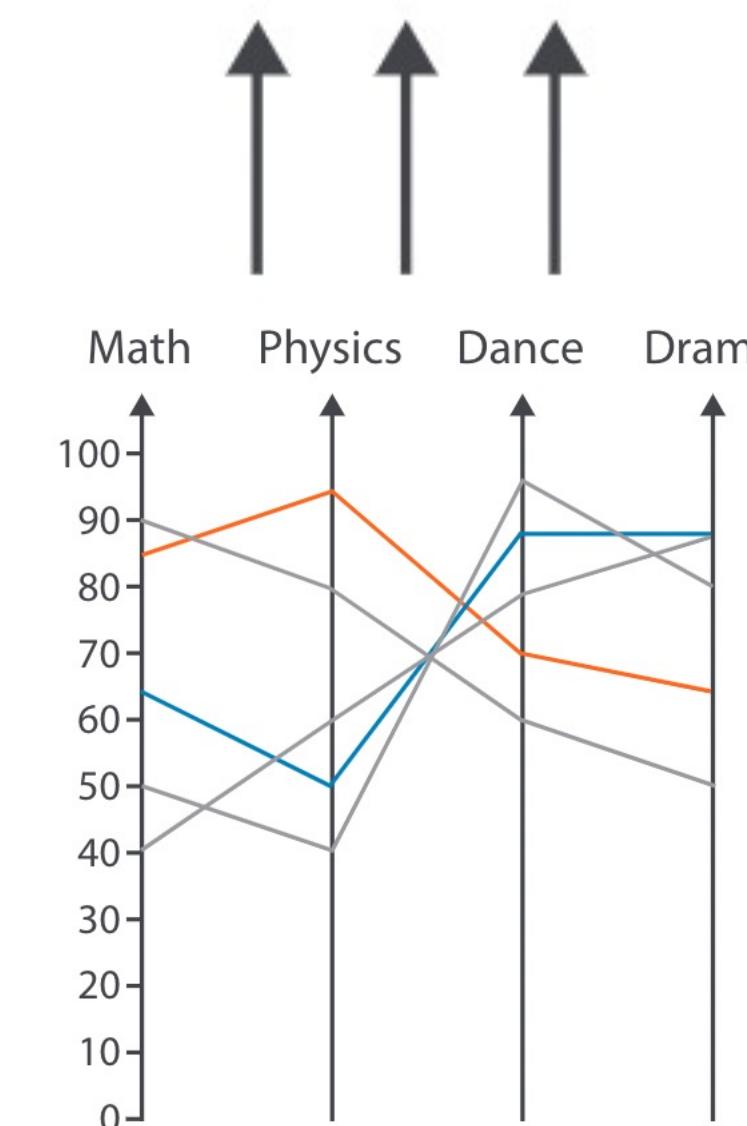
Axis Orientation

→ Rectilinear



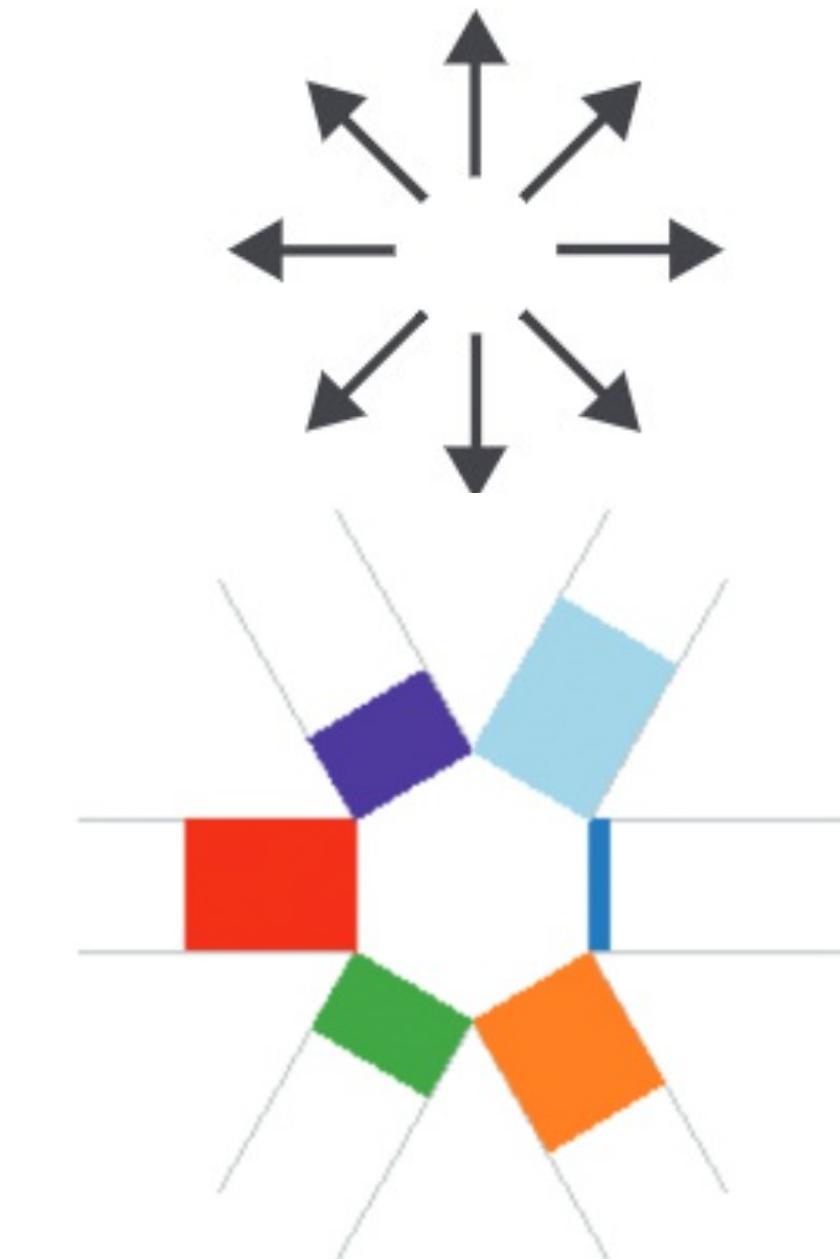
BAR CHART

→ Parallel



PARALLEL COORDINATES PLOT

→ Radial

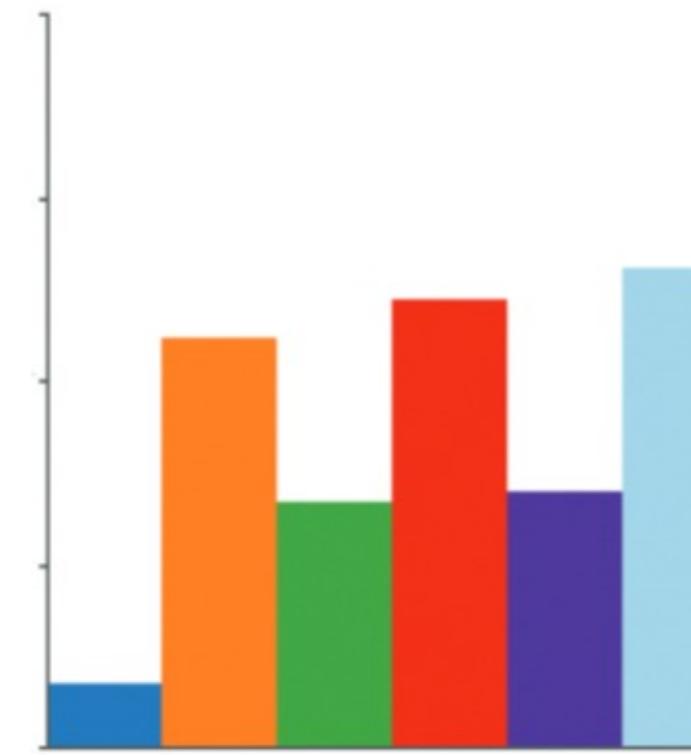


RADIAL BAR CHART

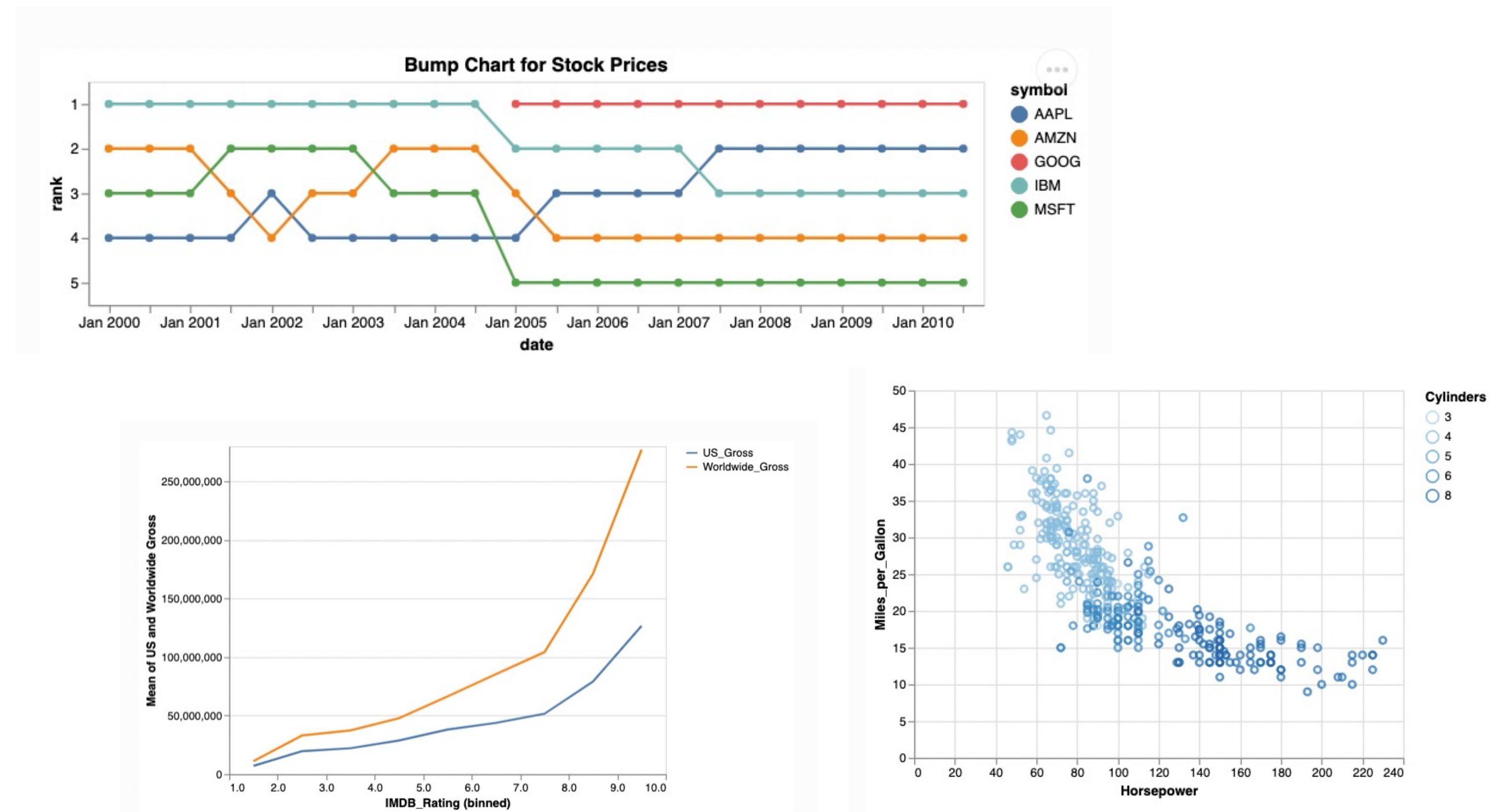
Arrange (tables)

Axis Orientation

→ Rectilinear



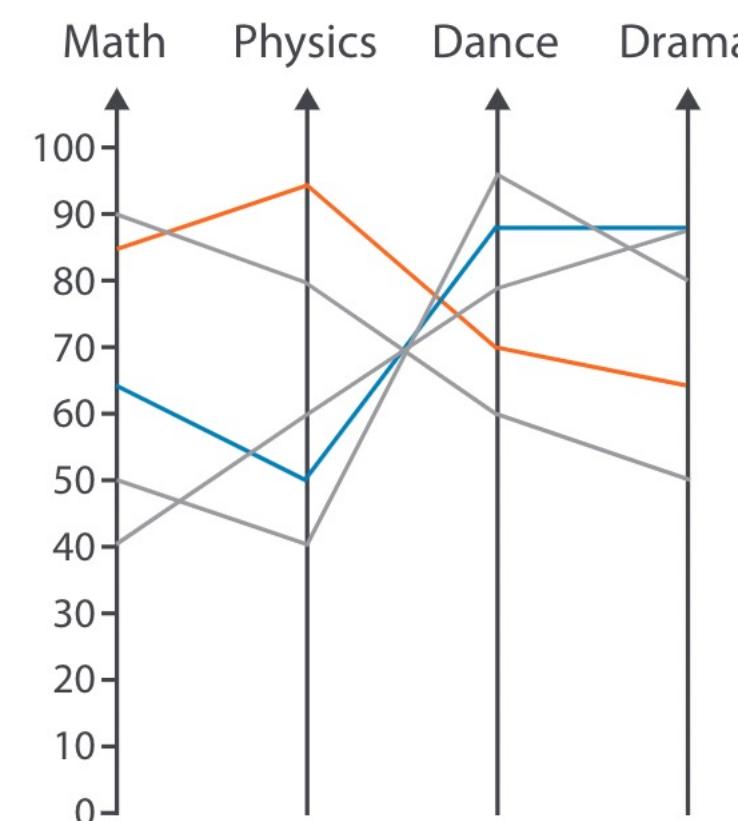
BAR CHART



Arrange (tables)

Axis Orientation

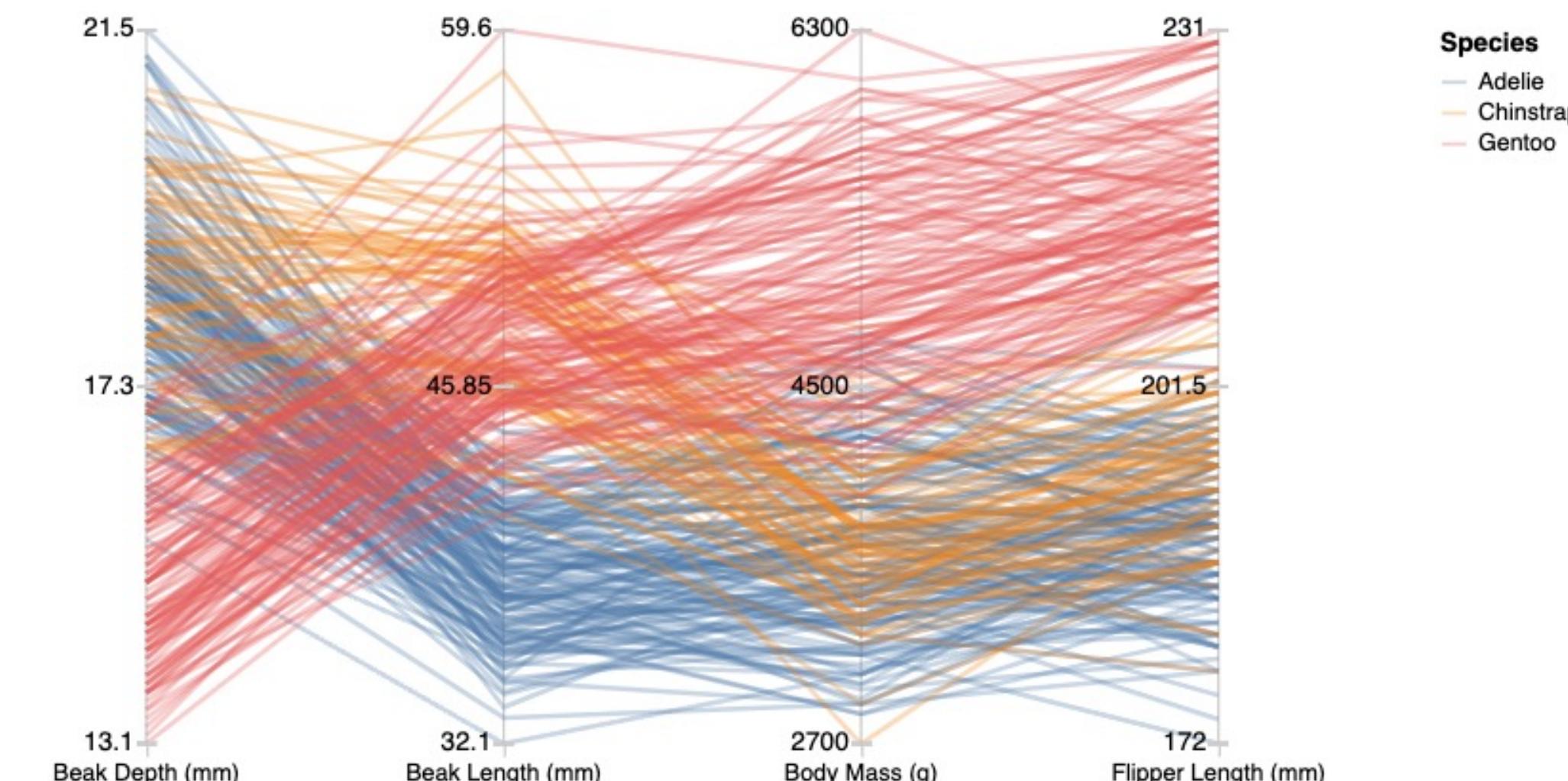
→ Parallel



PARALLEL COORDINATES PLOT

| | r = 0.1 * | r = 0.3 | r = 0.5 | r = 0.7 | r = 0.9 * | overall |
|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| pcp-negative | pcp-negative | scatterplot-positive | scatterplot-negative | scatterplot-negative | scatterplot-positive | scatterplot-positive |
| scatterplot-positive | scatterplot-positive | pcp-negative | scatterplot-positive | scatterplot-positive | pcp-negative | pcp-negative |
| scatterplot-negative | scatterplot-negative | scatterplot-negative | pcp-negative | pcp-negative | scatterplot-negative | scatterplot-negative |
| stackedbar-negative | stackedbar-negative | stackedbar-negative | stackedbar-negative | ordered line-positive | stackedbar-negative | stackedbar-negative |
| ordered line-positive | ordered line-positive | ordered line-positive | ordered line-positive | donut-negative | ordered line-positive | ordered line-positive |
| donut-negative | donut-negative | donut-negative | donut-negative | ordered line-negative | donut-negative | donut-negative |
| stackarea-negative | stackarea-negative | stackarea-negative | ordered line-negative | stackedbar-negative | stackarea-negative | stackarea-negative |
| ordered line-negative | ordered line-negative | ordered line-negative | stackarea-negative | stackedline-negative | ordered line-negative | ordered line-negative |
| stackedline-negative | stackedline-negative | stackedline-negative | stackedline-negative | stackarea-negative | stackedline-negative | stackedline-negative |
| pcp-positive | pcp-positive | pcp-positive | pcp-positive | radar-positive | pcp-positive | pcp-positive |
| radar-positive | radar-positive | radar-positive | radar-positive | pcp-positive | radar-positive | radar-positive |
| line-positive |

<https://visualthinking.psych.northwestern.edu/publications/Harrison-weberlaw-infovis2014.pdf>

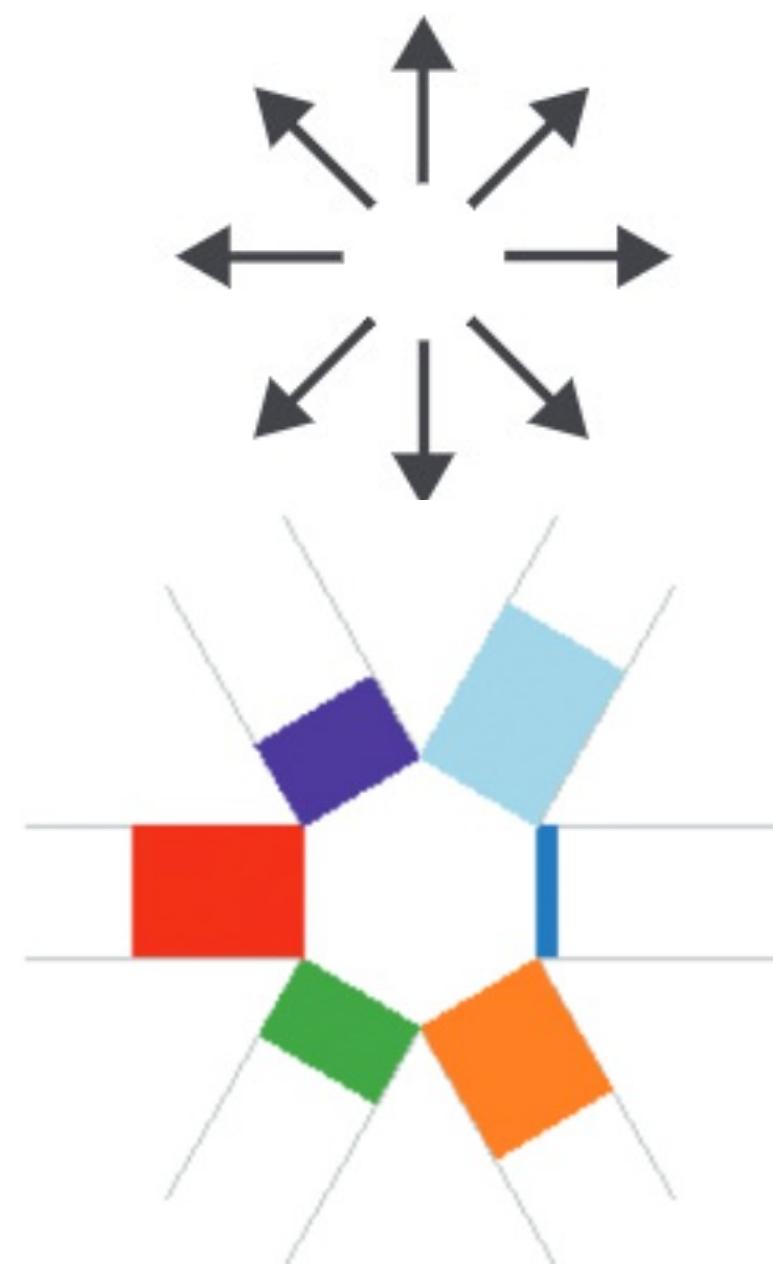


https://vega.github.io/vega-lite/examples/parallel_coordinate.html

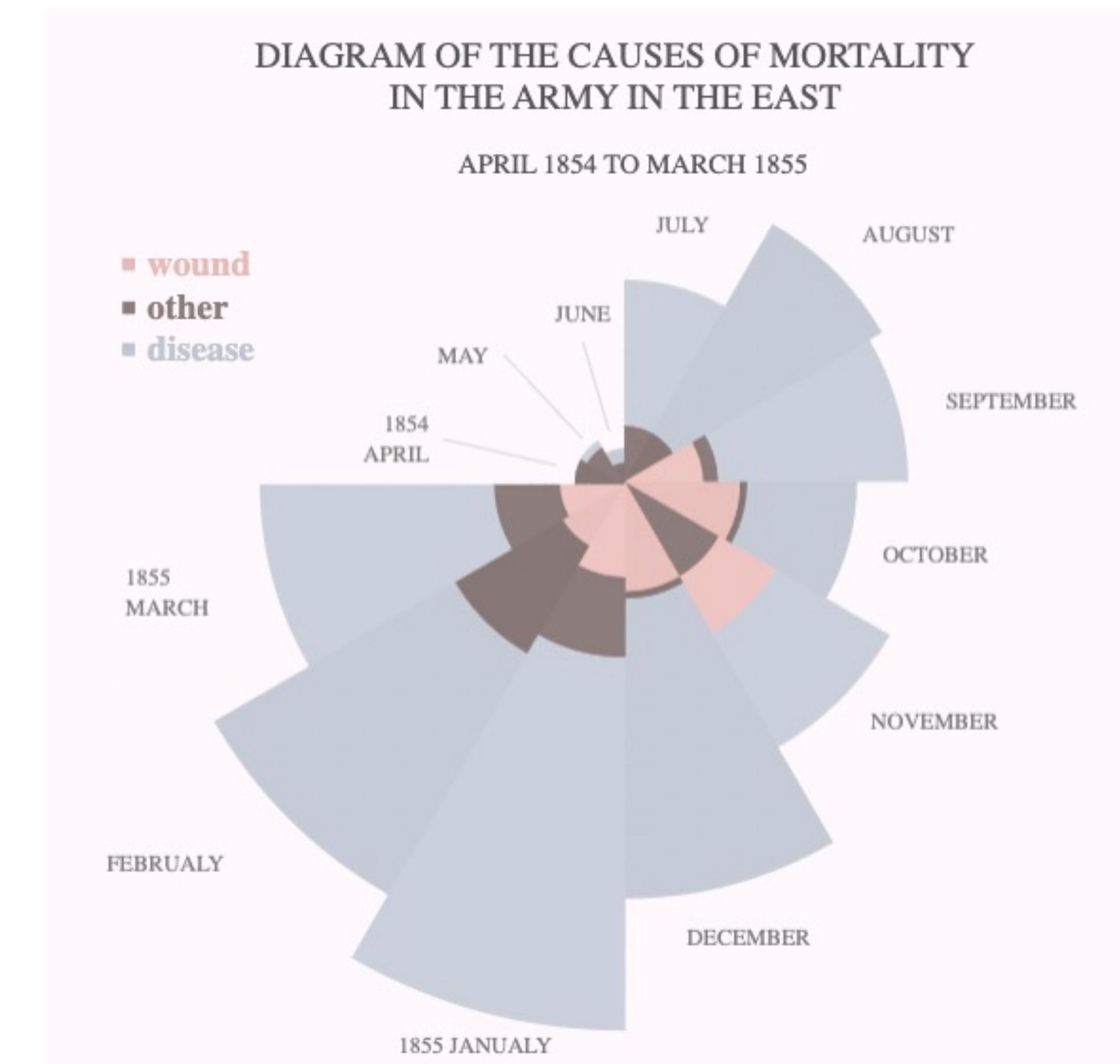
Arrange (tables)

Axis Orientation

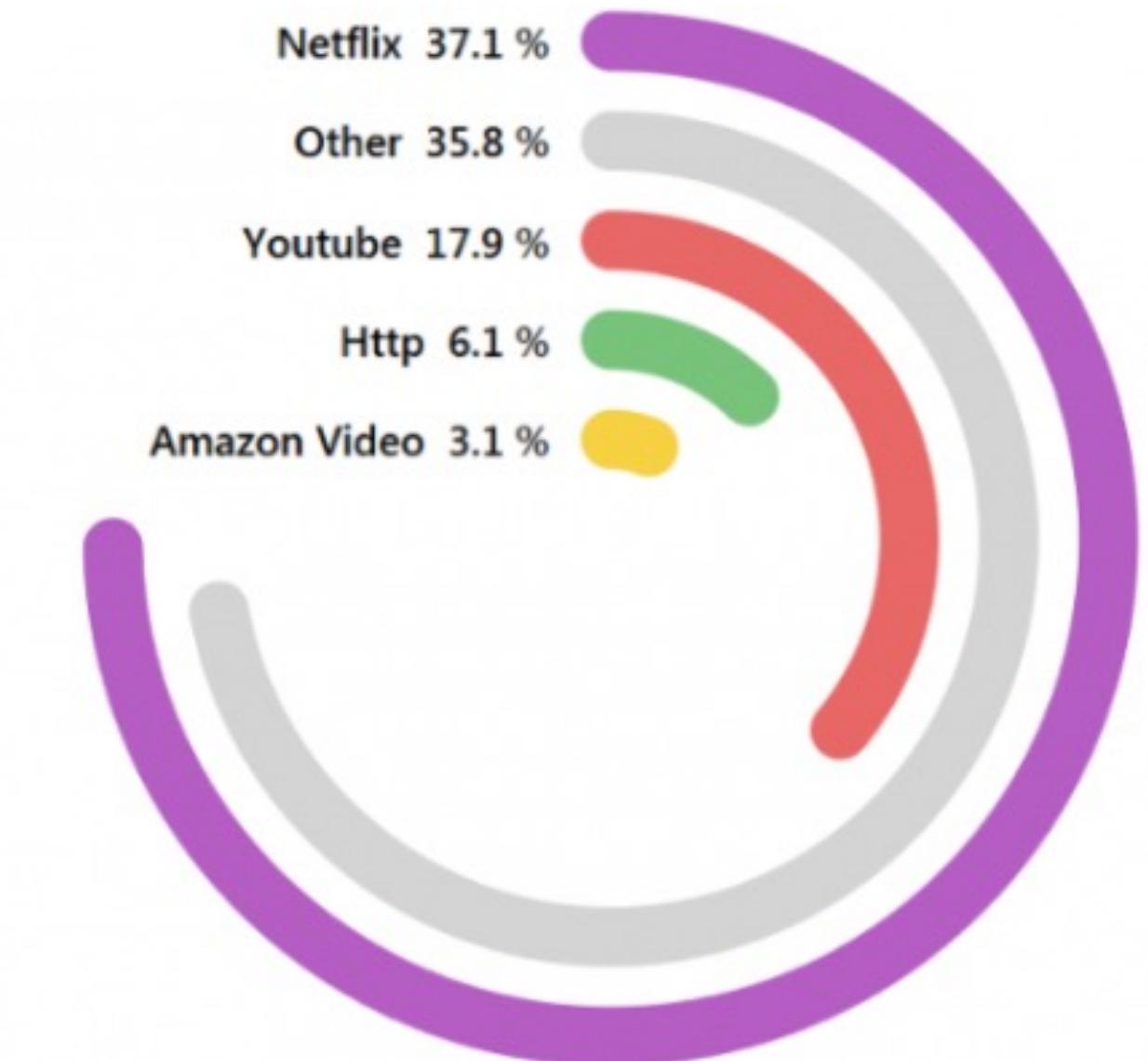
→ Radial



RADIAL BAR CHART



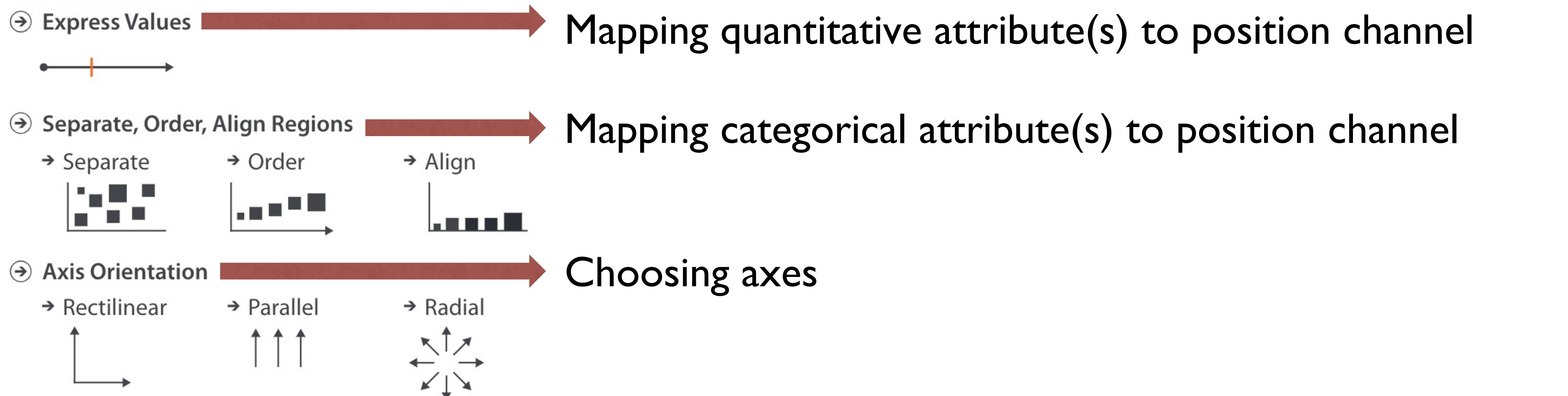
<https://public.tableau.com/app/profile/satoshi.ganeko/viz/NaichingaleDiagram/Diagram>



<https://tableau.toanhoang.com/radial-bar-chart-tutorial/>

Arrange (tables)

ARRANGE

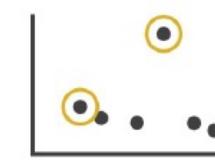


Visual Encodings and Tasks

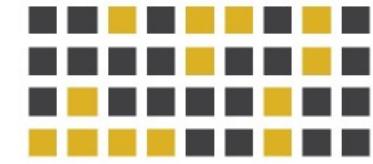
Low-level tasks:

⌚ Query

→ Identify → Compare



→ Summarize



AN ANALYTIC TASK TAXONOMY

- Retrieve Value
- Filter
- Compute Derived Value
- Find Extremum
- Sort
- Determine Range
- Characterize Distribution
- Find Anomalies
- Cluster
- Correlate

More granular visualization tasks:

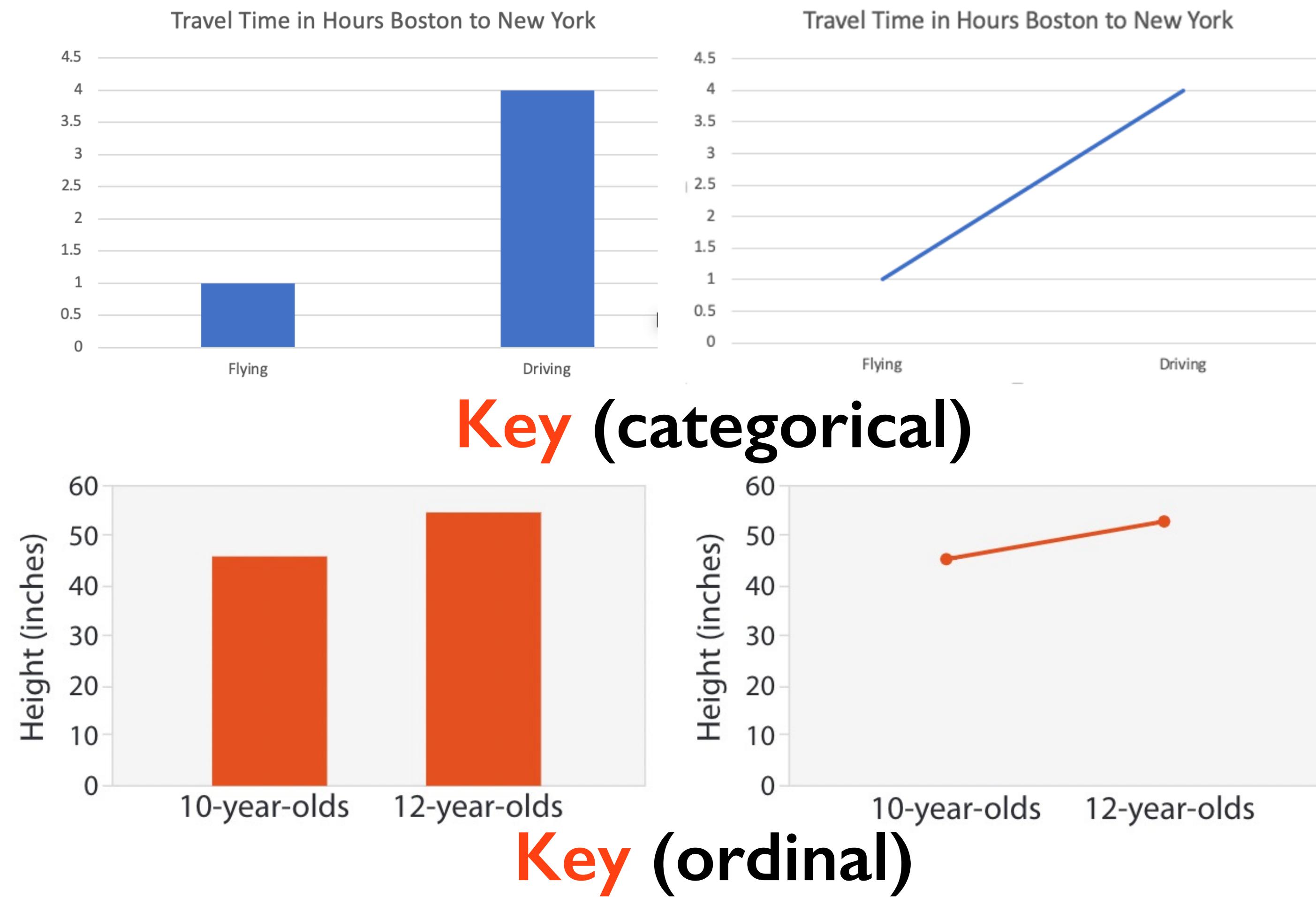
Comparison Concept visualisation Correlation

Distribution Geographical data Part to whole Trend over time

Amar et al. Low-level components of analytic activity in information visualization

Visual Encodings and Tasks

→ Be aware of the attribute type of your key and what your visualization communicates



Visual Encodings and Tasks

Work in pairs to sketch two visual encodings that would be good for your assigned task.

More granular visualization tasks:

Comparison Concept visualisation Correlation

Distribution Geographical data Part to whole Trend over time

AN ANALYTIC TASK TAXONOMY

- Retrieve Value
- Filter
- Compute Derived Value
- Find Extremum
- Sort
- Determine Range
- Characterize Distribution
- Find Anomalies
- Cluster
- Correlate

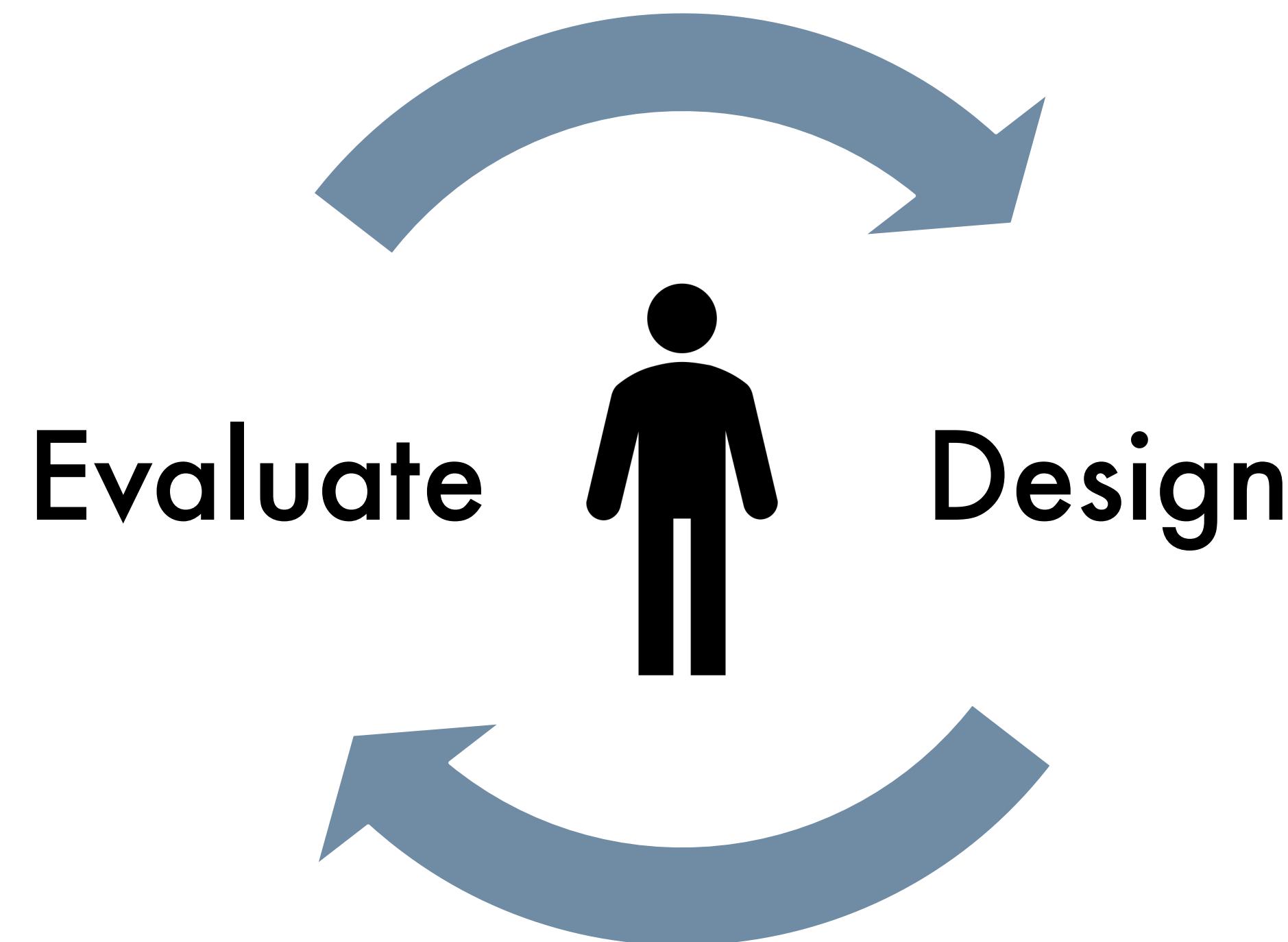
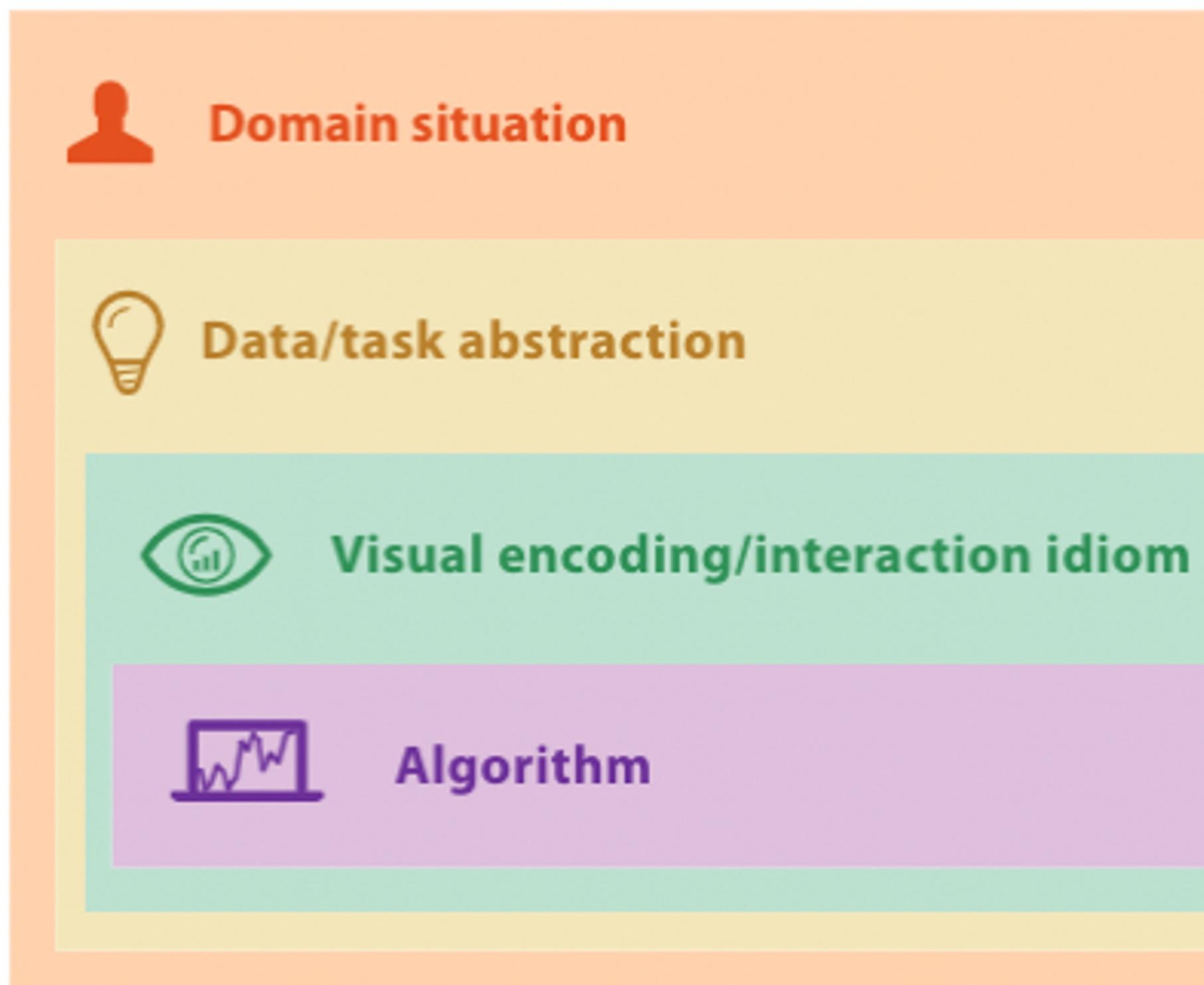
Amar et al. Low-level components of analytic activity in information visualization

Let's take a break! Stretch, go
for a walk, be social ☺
Be back here in 10 mins.

SKETCHING NEW VISUALIZATIONS

Human-Centered, Iterative Design

Human-Centered, Iterative Design



Human-Centered, Iterative Design

- Ground our designs in human needs
- Gather an understanding of the domain situation from our end users
- Check our work by iterating, i.e. continually verifying and evaluating our proposed visualization tool

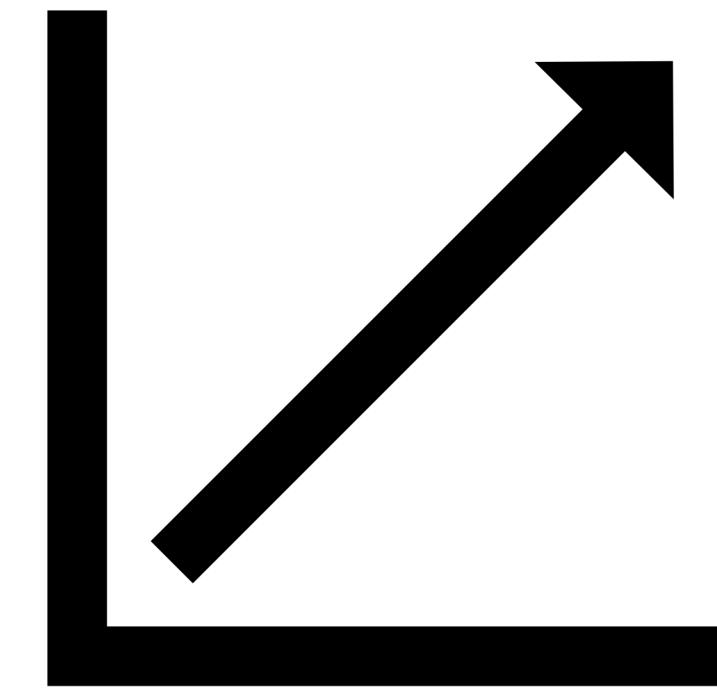
Task/Data Abstraction → Visual Encoding

1. Look at the tasks you need to support
2. Identify Visual Encodings that support those tasks and work with your attribute types
→ Ex. Bar chart vs. line chart, bar chart vs scatter plot

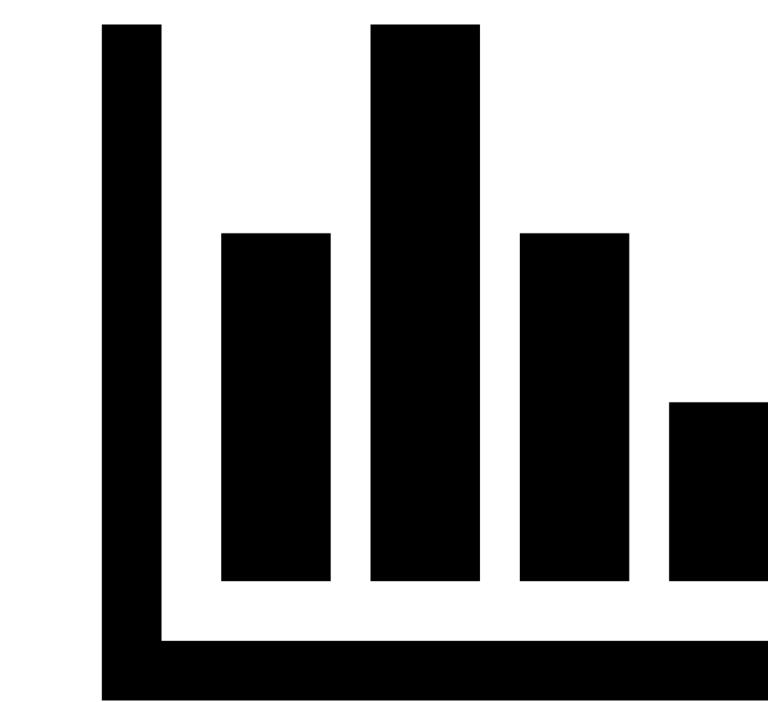


Comparison

vs

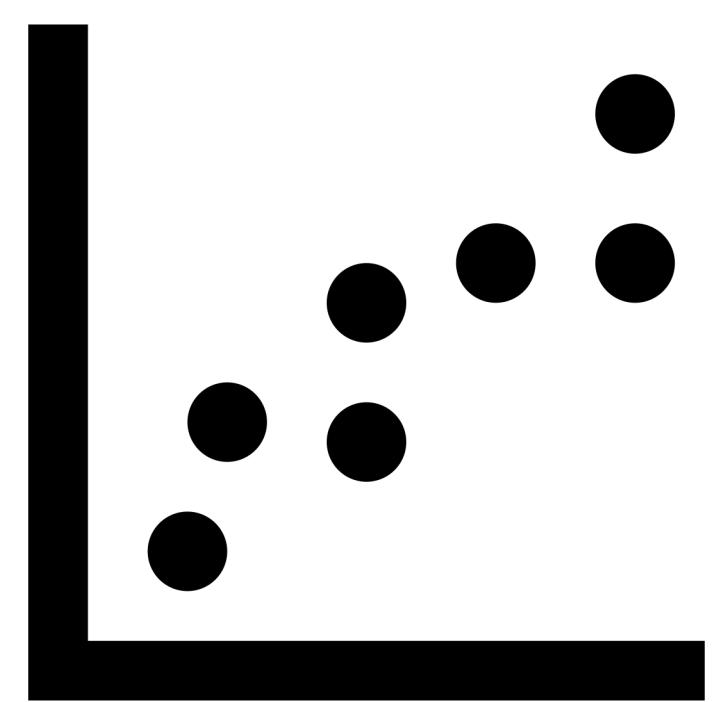


Trend



Quantitative vs.
Categorical

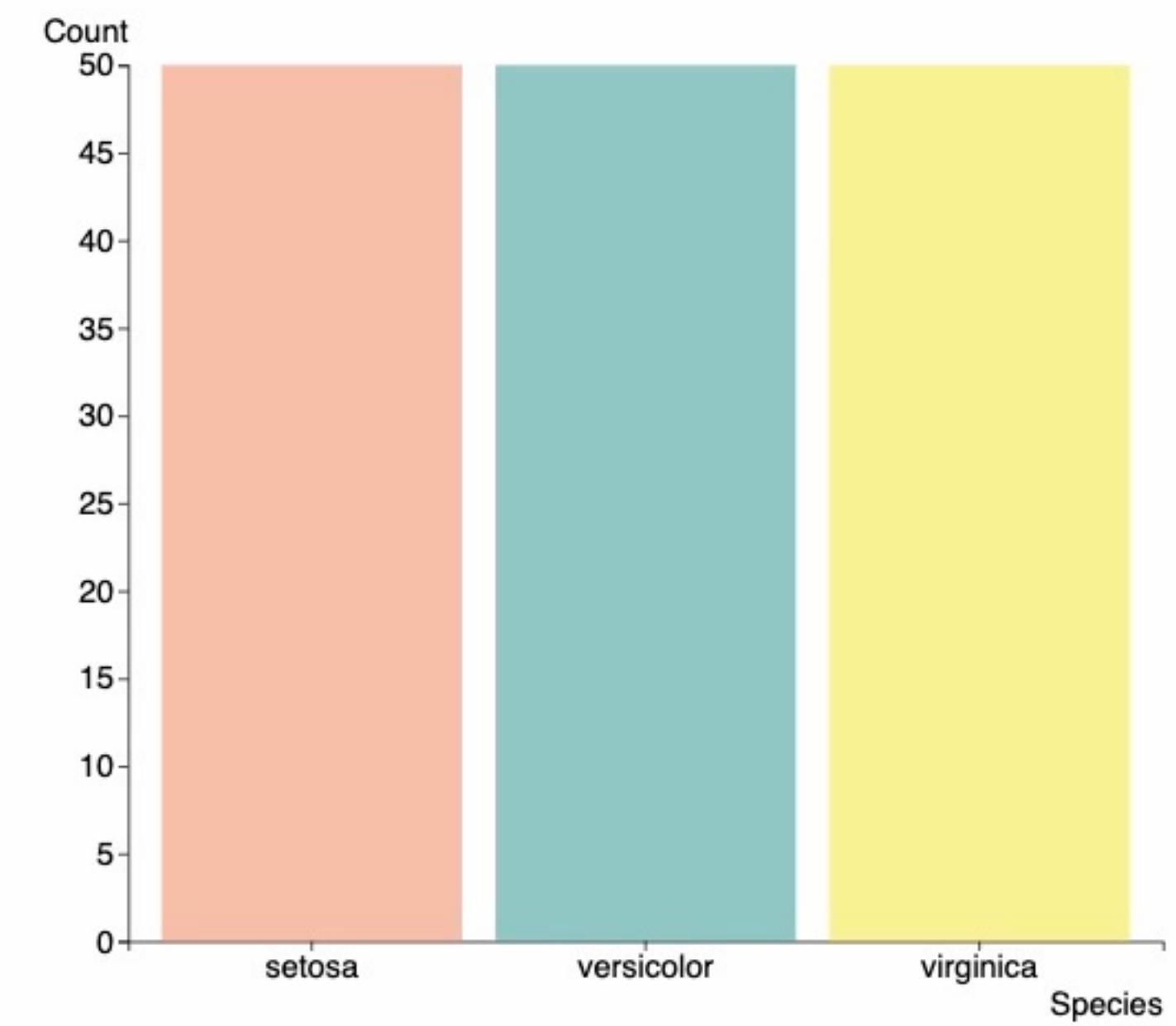
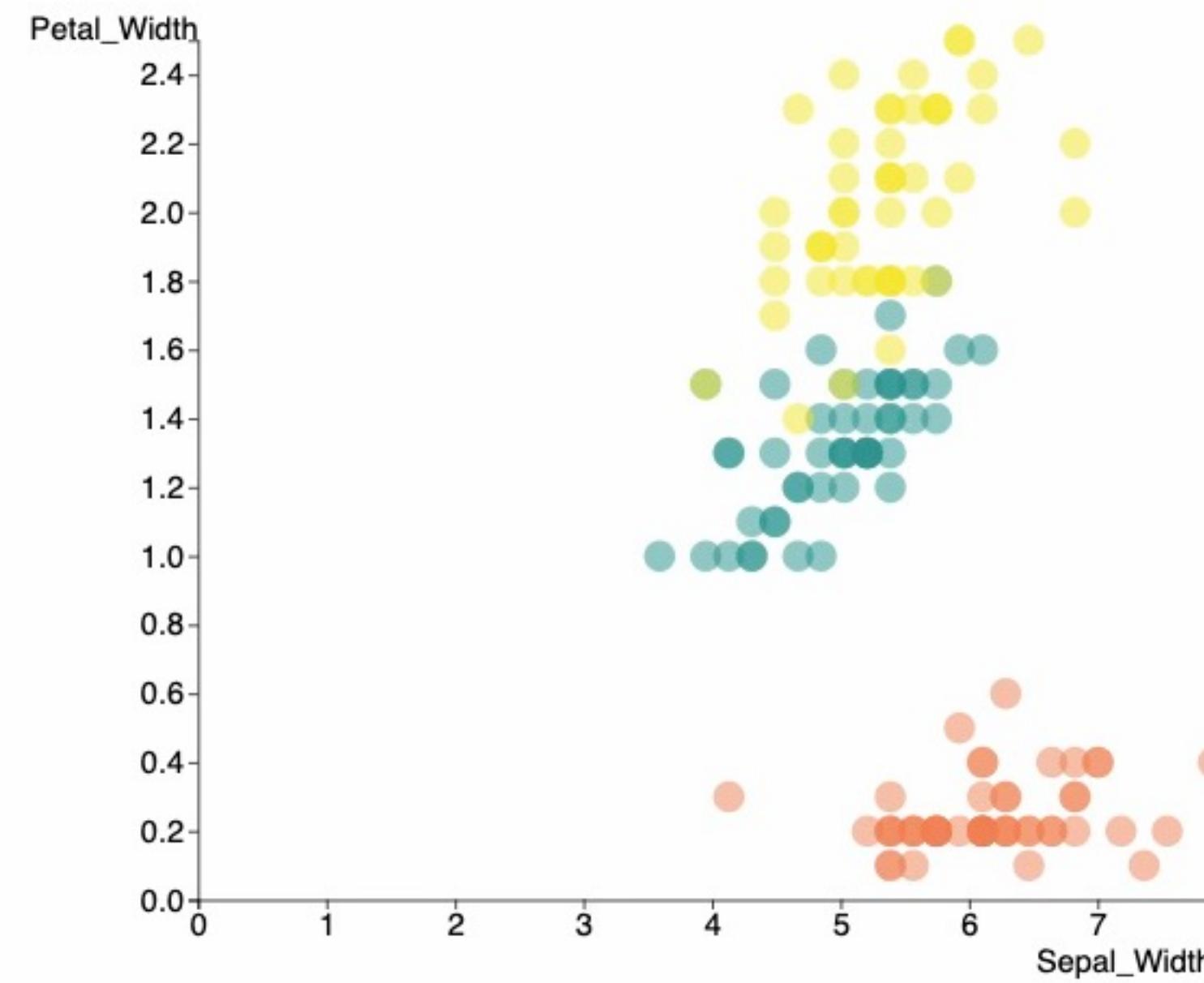
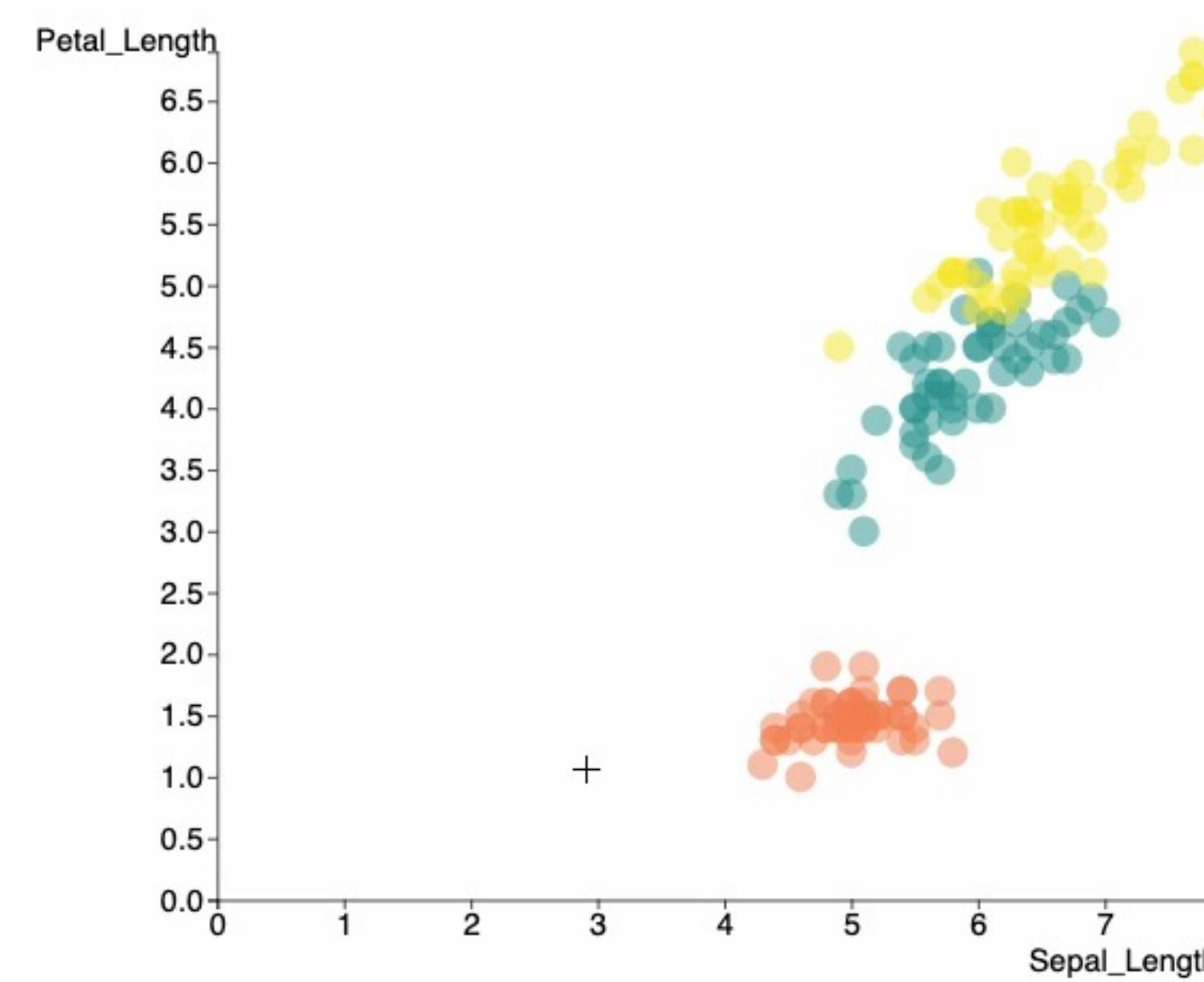
vs



Quantitative vs
Quantitative

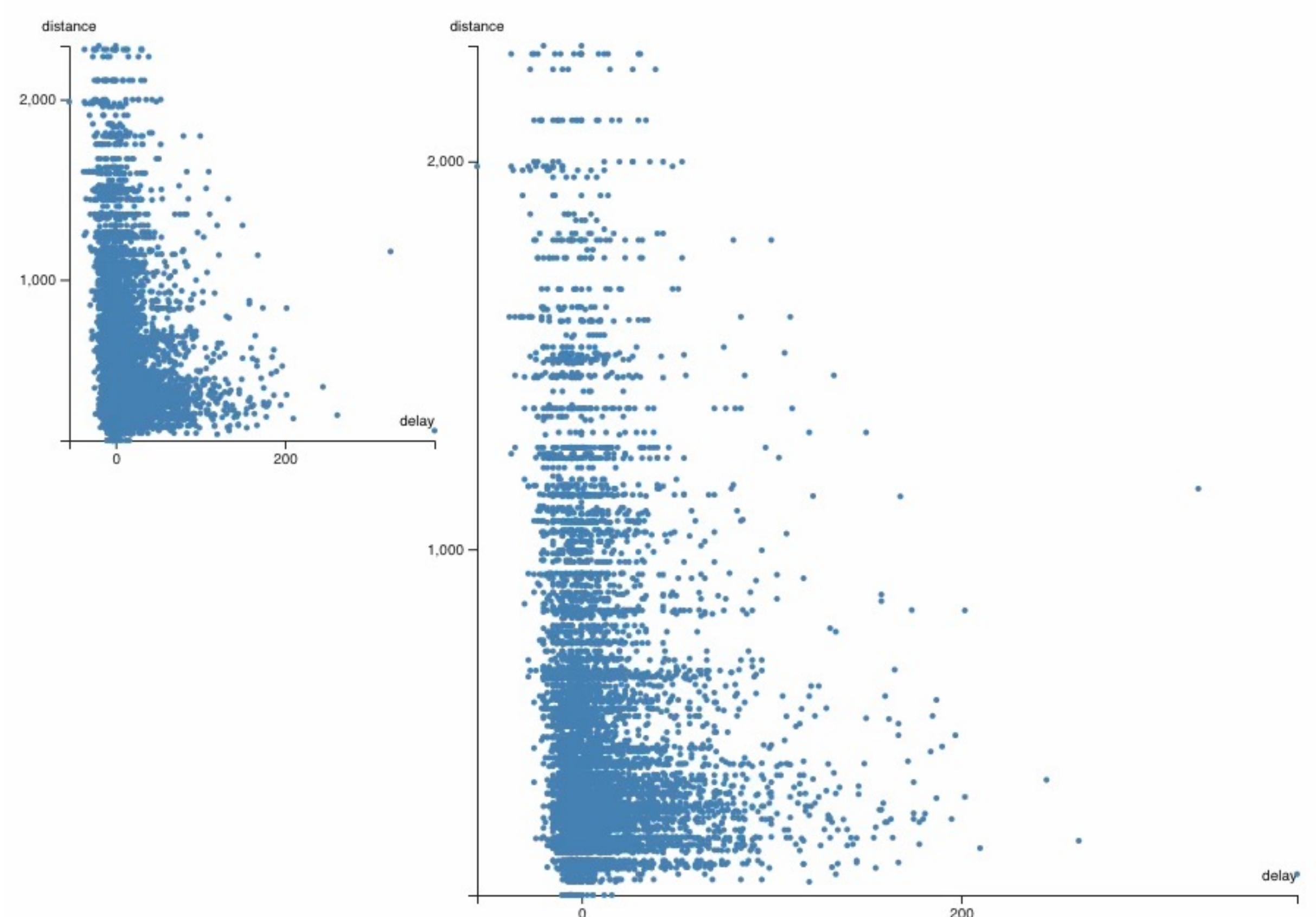
Task/Data Abstraction → Visual Encoding

3. Think about linking tasks together (i.e. coordinating multiple visual encodings)



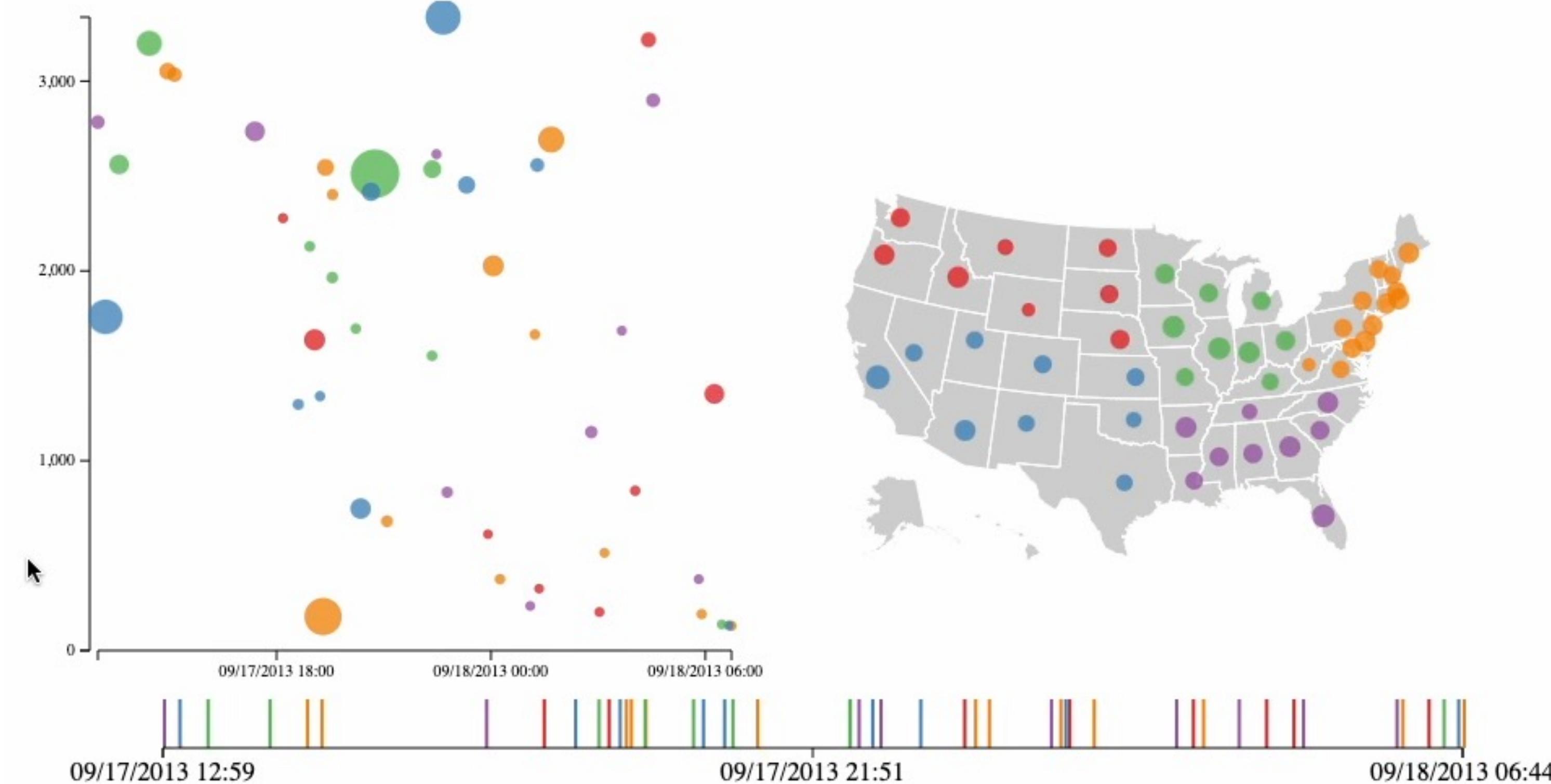
Task/Data Abstraction → Visual Encoding

3. Think about linking tasks together (i.e. coordinating multiple visual encodings)



Task/Data Abstraction → Visual Encoding

3. Think about linking tasks together (i.e. coordinating multiple visual encodings)



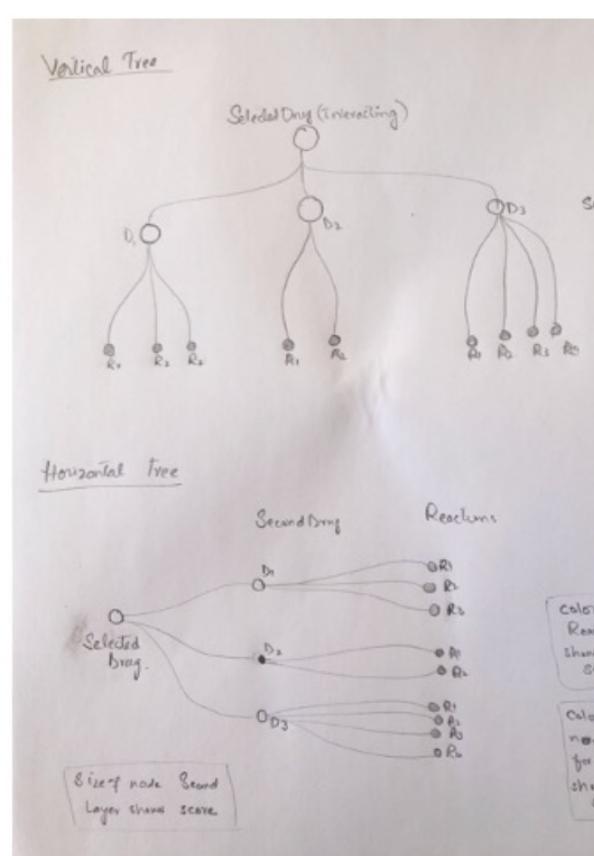
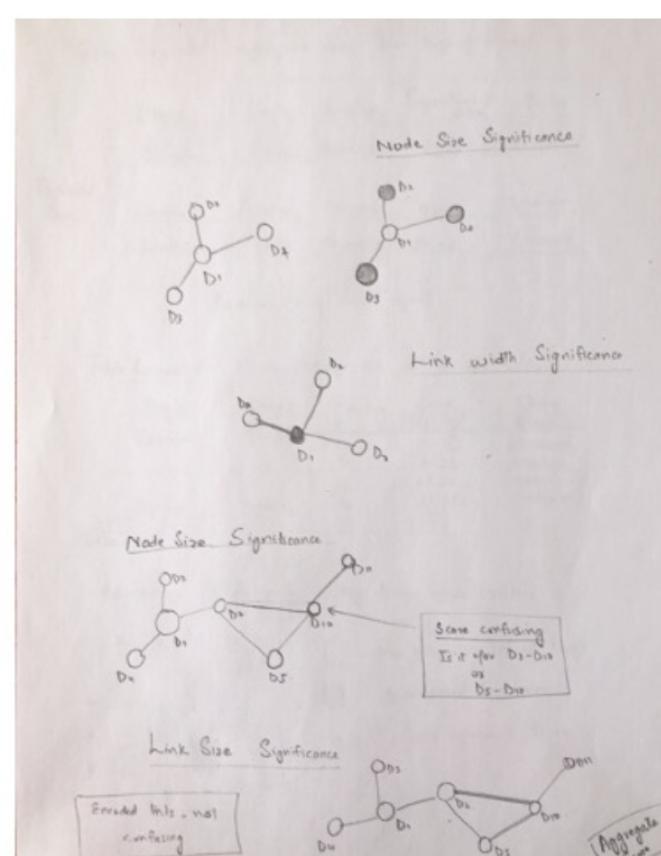
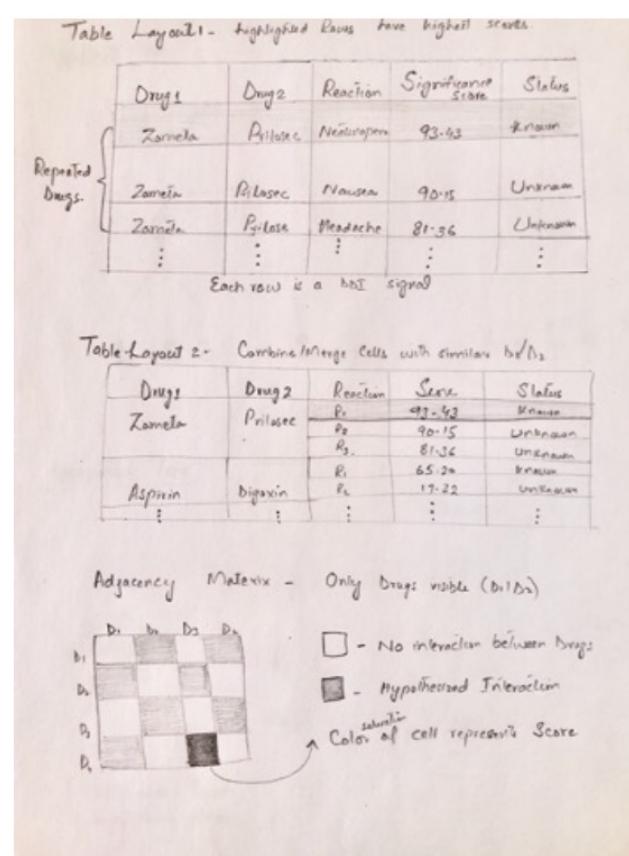
Task/Data Abstraction → Visual Encoding

3. Be creative & sketch, review, sketch

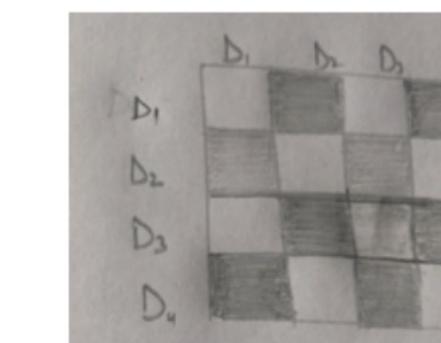
**Ex.
DIVA**

Visual Design and Prototypes to Get User Feedback

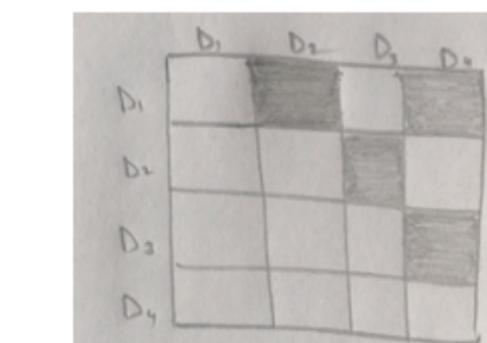
Given the complexity of the DDI signals and user tasks, designing a single visualization is not feasible. Based on literature review and heuristic analysis of different visualization techniques for the underlying data, we considered various visualizations.



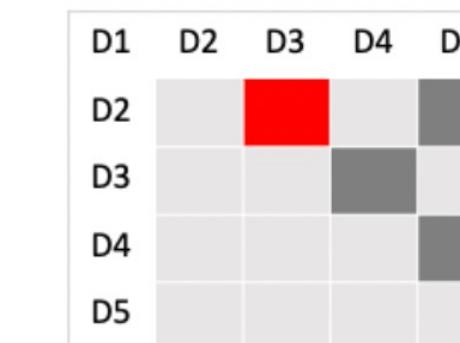
To help users explore the set of all the machine-generated drug-drug interactions (DDIs) the first suitable candidate is an Adjacency Matrix (below figures). Due to sparsity of the matrix for real data, alternatively, a node-link diagram is designed.



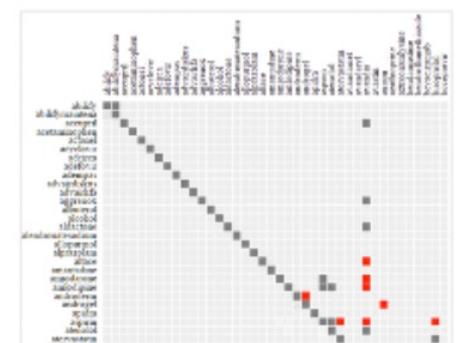
Each axis represents four drugs (D₁, D₂, etc.). Shaded cells represent an interaction between two drugs exist in the machine generated signals.



No order between DDIs. Interaction between D₁-D₂ is same as D₂-D₁. Only used the upper triangular matrix.

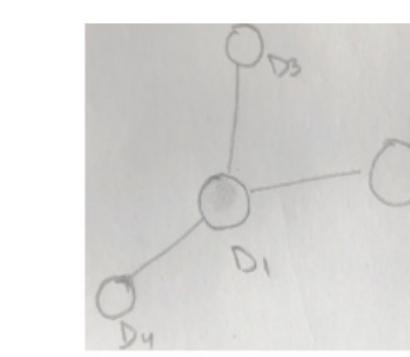


Color of the cell is mapped to the significance score of the DDI interaction used by the machine learning algorithm to rank signals.

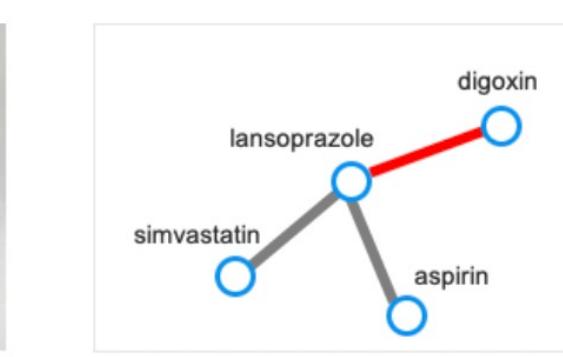


Adjacency matrix using D3.js with real DDI data has high sparsity, due to hundreds of drugs having unequal number of interactions with each other

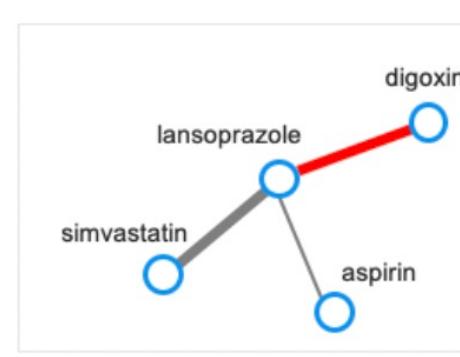
In the node-link diagrams (following figure), the nodes are mapped to the drugs and the links depict the interaction between drugs. The visual encodings, i.e., color and size of the links (Screening view) and nodes (Triage view) are mapped to the significance score of the signals and status of the reactions, respectively.



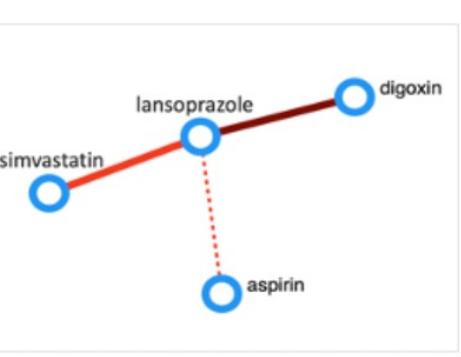
Nodes represent drugs, and links between nodes represent a machine-generated drug-drug interaction.



Links are encoded with score using color hue. Red color shows a high score, grey means a low score.



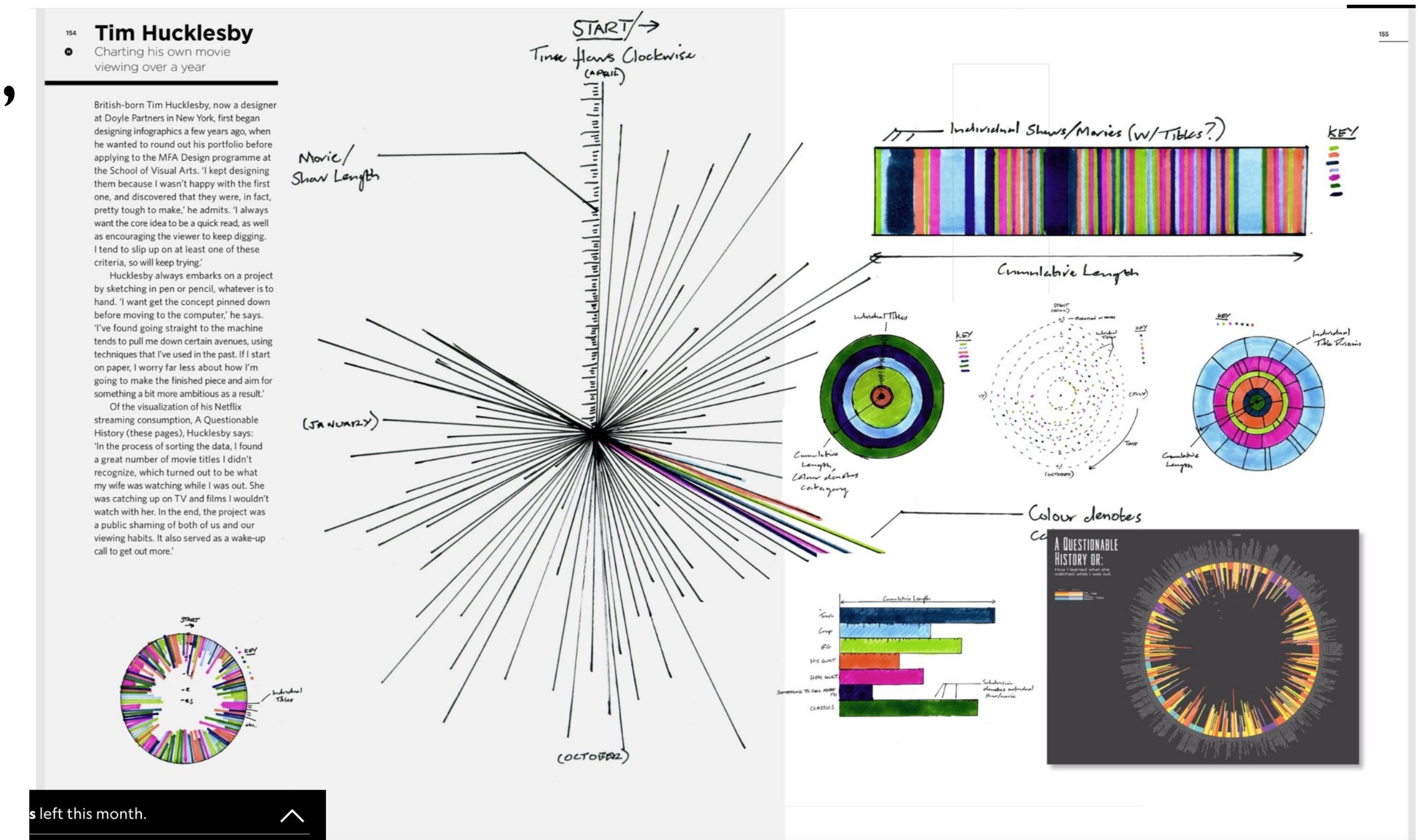
The signal status (known or unknown) is mapped to the link size. Thin = known signal and thick = unknown.



In the final design, color saturation is used to encode score. Both link shape and size are used to encode status.

Task/Data Abstraction → Visual Encoding

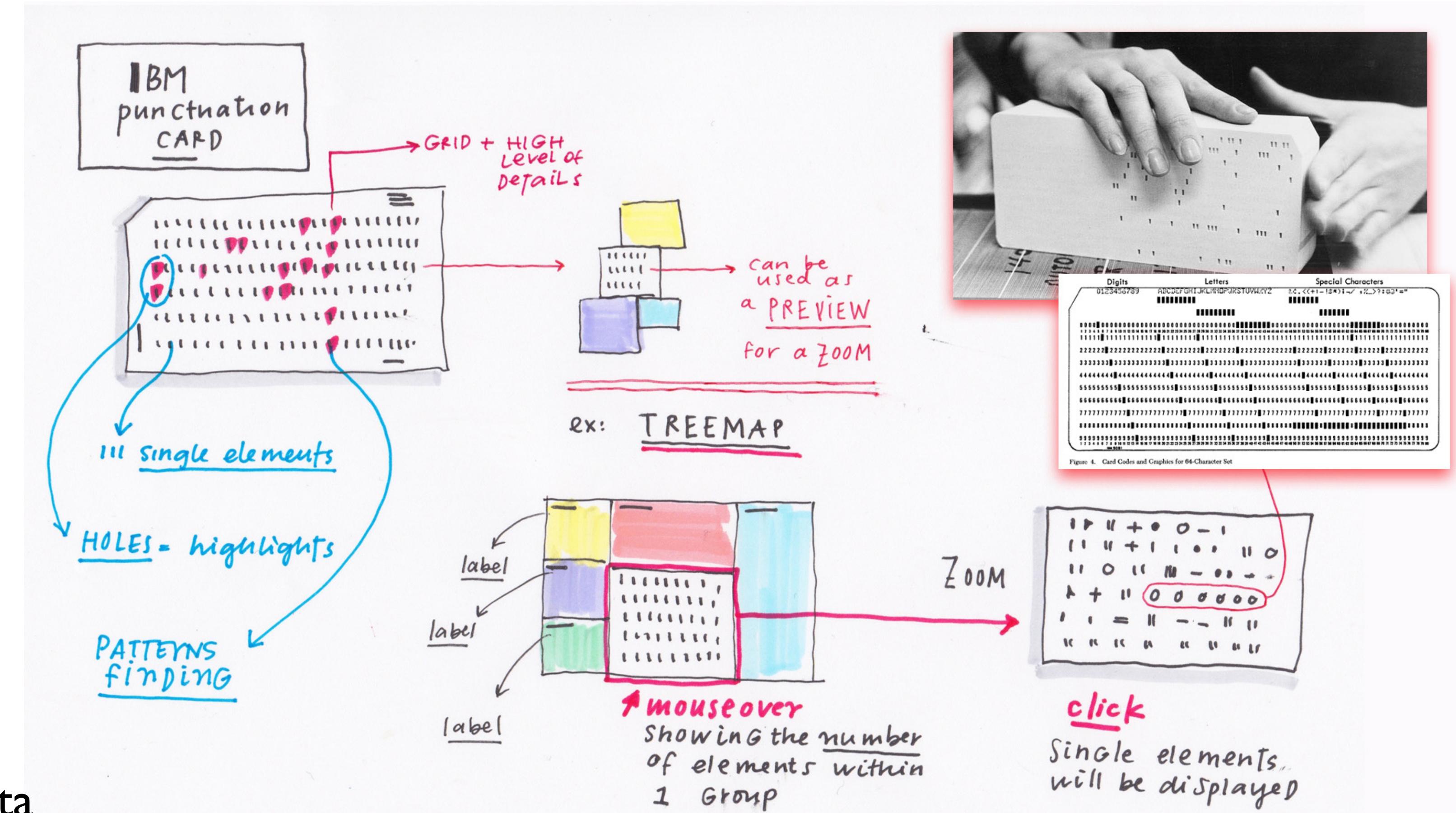
3. Be creative & sketch, review, sketch



<https://www.nationalgeographic.com/science/article/2015704-datapoints-sketching-data>

Task/Data Abstraction → Visual Encoding

3. Be creative & sketch, review, sketch



Task/Data Abstraction → Visual Encoding

3. Be creative & sketch, review, sketch

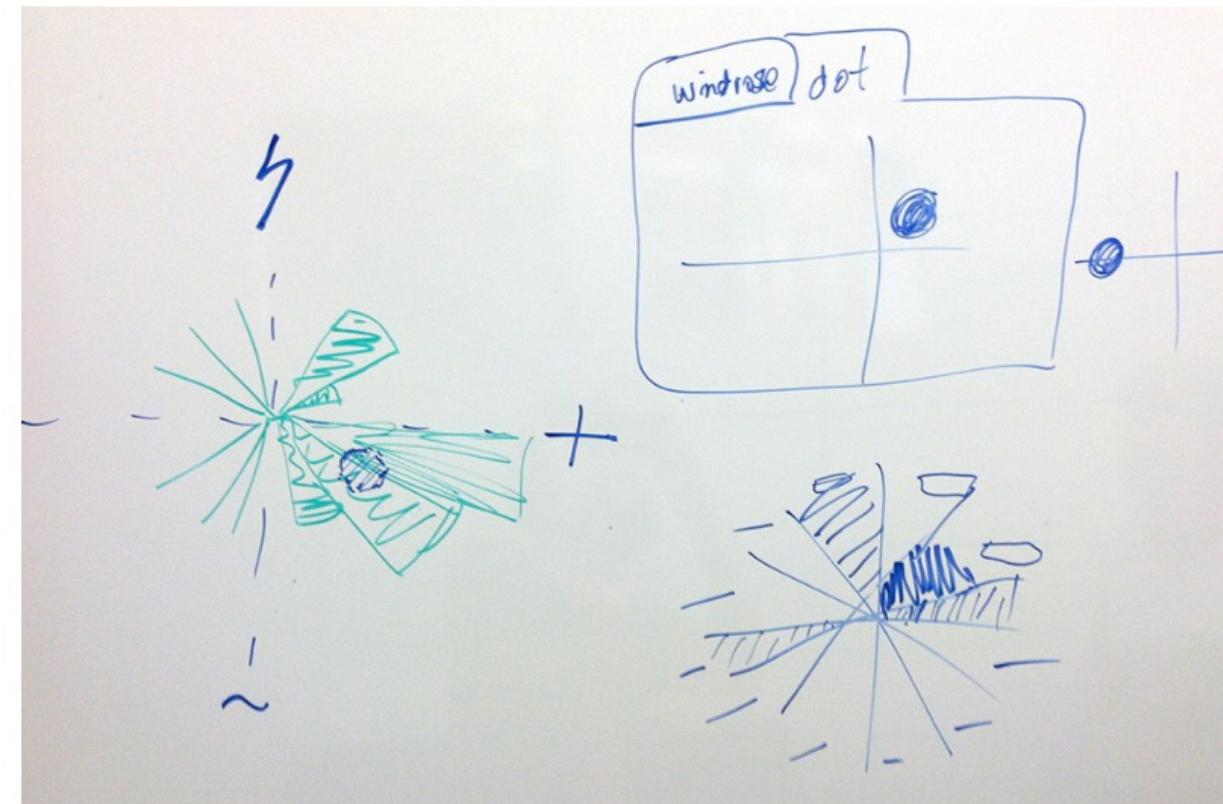


Figure 2. Example of a whiteboard outcome of converging collaboration.

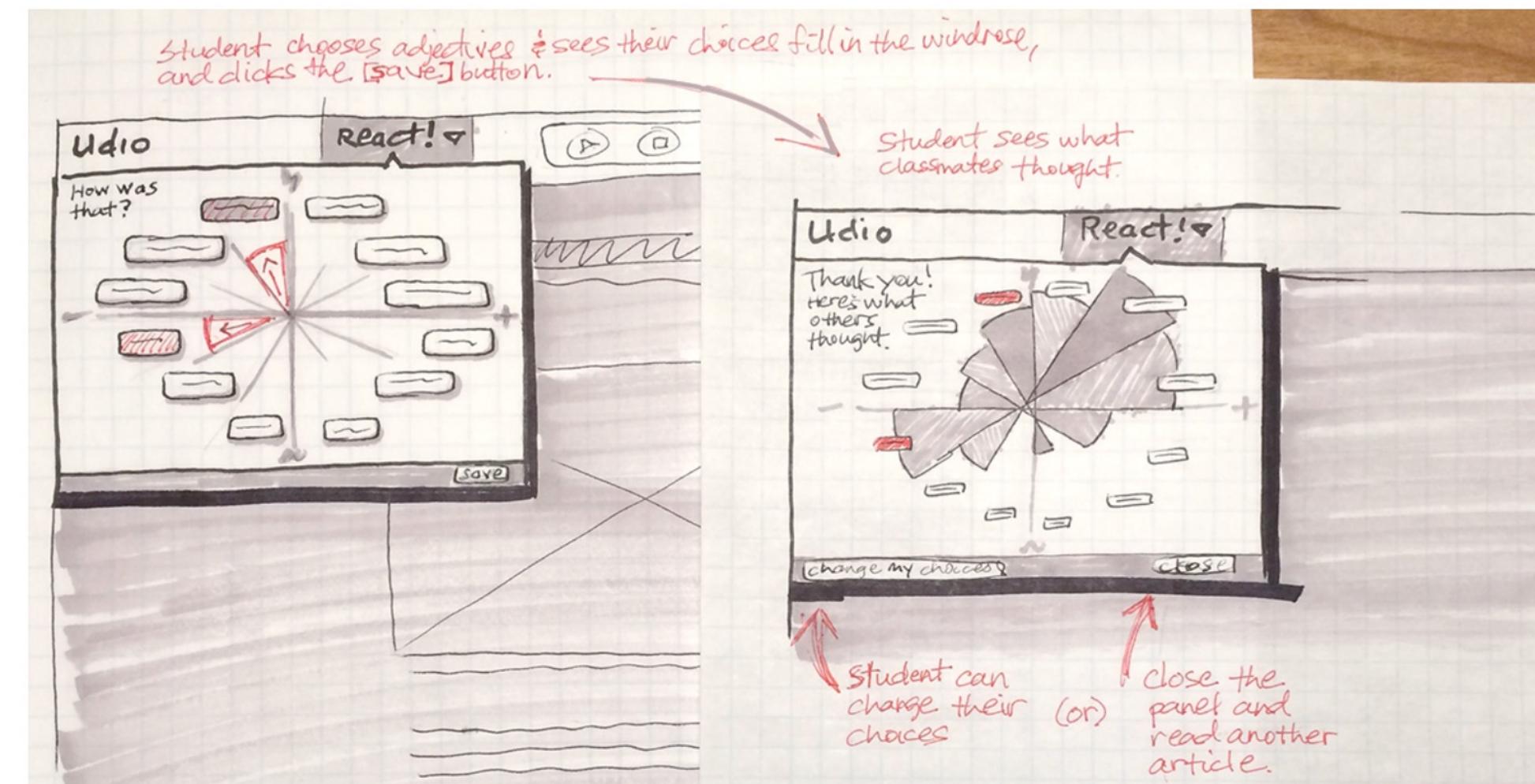
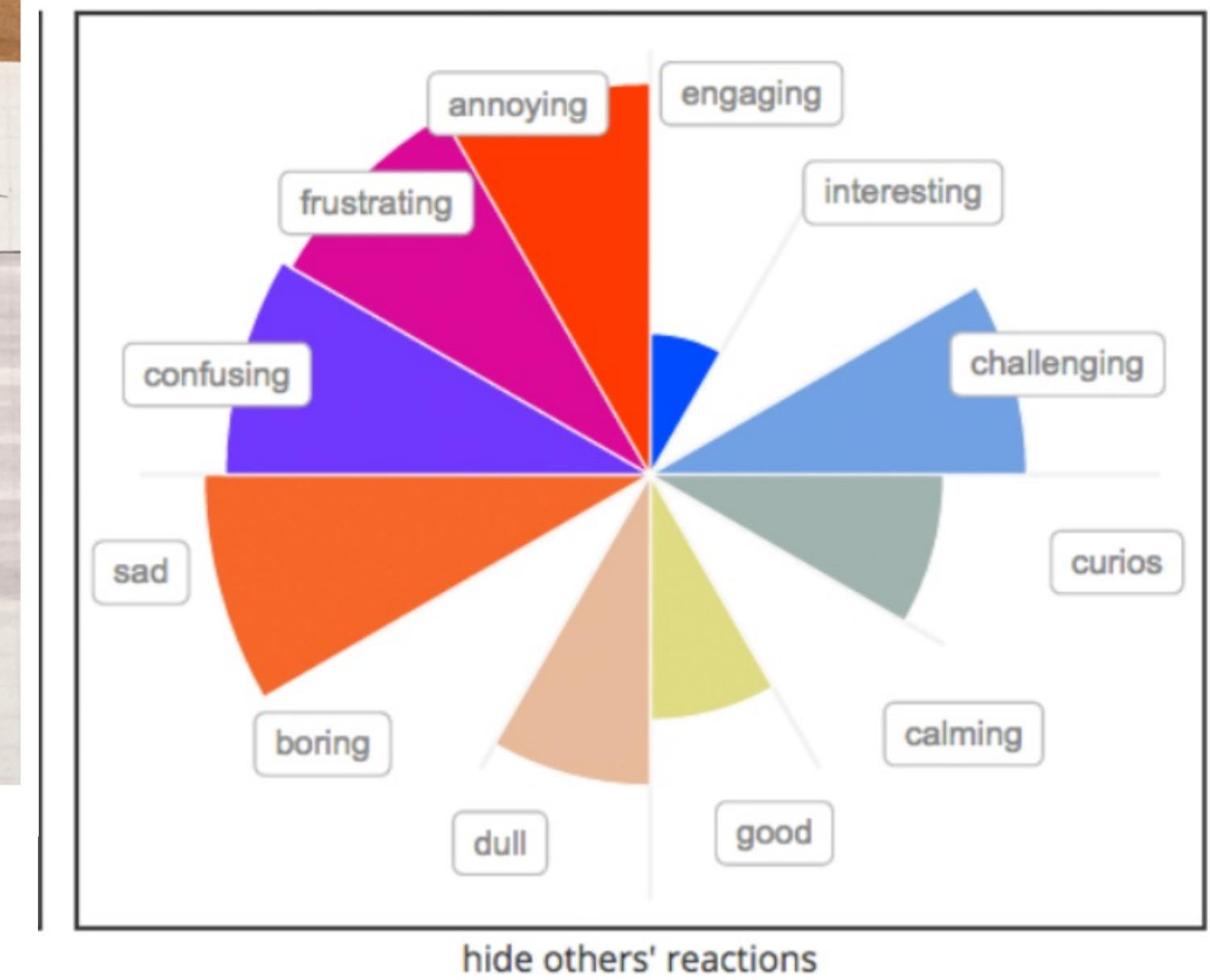


Figure 3. Example of refined sketch of "React" data visualization.



Summary

Today we:

- Reviewed arranging visual encodings for tables
- Reviewed iterative design / sketching new visualizations

ic-09 is DUE today.

hw-05 is DUE before next class.