

CS49000-VIZ - Fall 2020

Introduction to Data Visualization

Manipulate View

Lecture 14

Slides credit: Tamara Munzner, UBC

How?

Encode

→ Arrange

→ Express



→ Separate



→ Order



→ Align



→ Use



→ Map

from **categorical** and **ordered** attributes

→ Color

→ Hue



→ Saturation



→ Luminance



→ Size, Angle, Curvature, ...



→ Shape



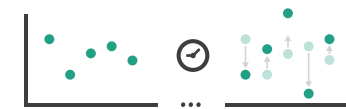
→ Motion

Direction, Rate, Frequency, ...

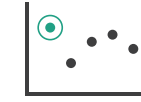


Manipulate

→ Change



→ Select

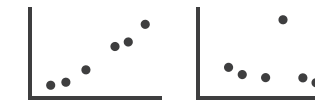


→ Navigate

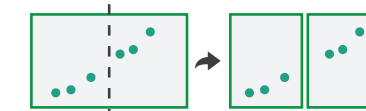


Facet

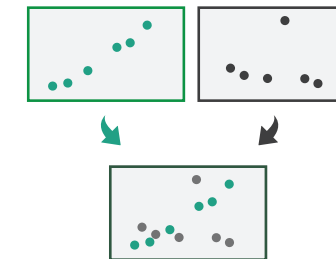
→ Juxtapose



→ Partition



→ Superimpose



Reduce

→ Filter



→ Aggregate



→ Embed



What?

Why?

How?

How?

Encode

→ Arrange

→ Express



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from **categorical** and **ordered** attributes

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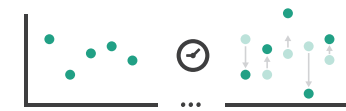
→ Motion

Direction, Rate, Frequency, ...

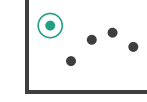


Manipulate

→ Change



→ Select



→ Navigate

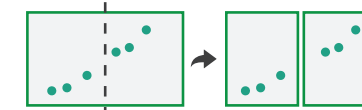


Facet

→ Juxtapose



→ Partition



→ Superimpose

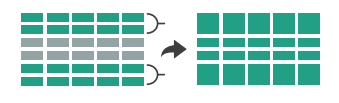


Reduce

→ Filter



→ Aggregate



→ Embed



What?

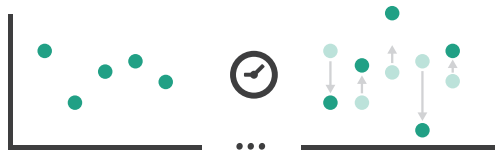
Why?

How?

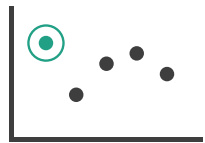
How to handle complexity: 3 more strategies

Manipulate

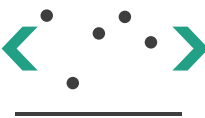
➔ Change



➔ Select

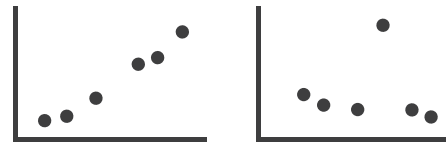


➔ Navigate

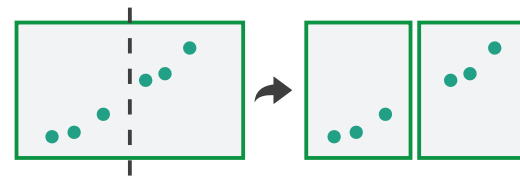


Facet

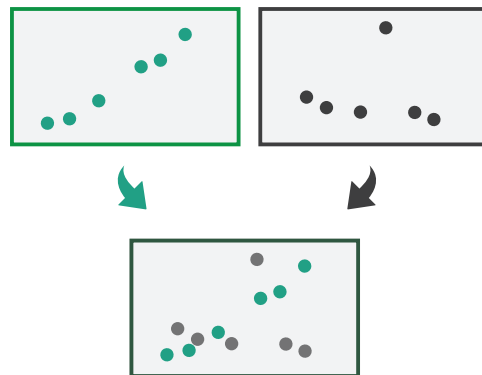
➔ Juxtapose



➔ Partition



➔ Superimpose



Reduce

➔ Filter



➔ Aggregate



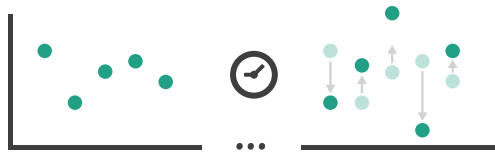
➔ Embed



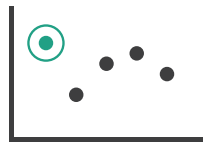
How to handle complexity: 3 more strategies

Manipulate

➔ Change



➔ Select

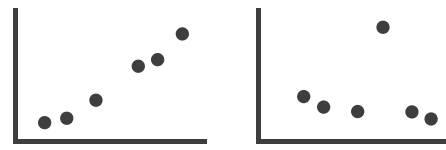


➔ Navigate

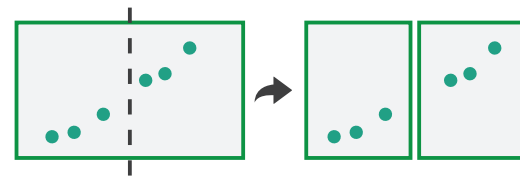


Facet

➔ Juxtapose



➔ Partition



➔ Superimpose



Reduce

➔ Filter



➔ Aggregate



➔ Embed

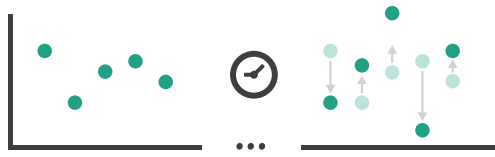


• change view over time

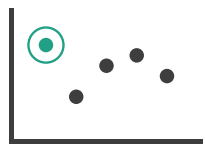
How to handle complexity: 3 more strategies

Manipulate

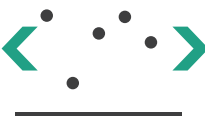
➔ Change



➔ Select

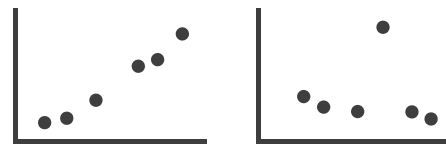


➔ Navigate

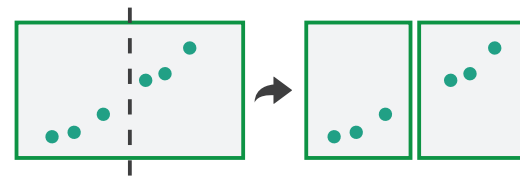


Facet

➔ Juxtapose



➔ Partition



➔ Superimpose



Reduce

➔ Filter



➔ Aggregate



➔ Embed

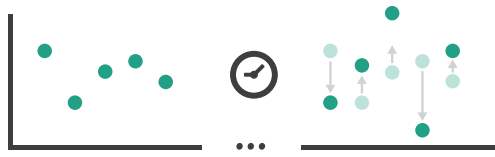


- change view over time
- facet across multiple views

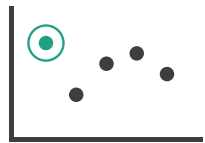
How to handle complexity: 3 more strategies

Manipulate

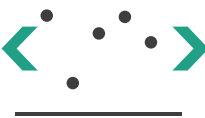
➔ Change



➔ Select

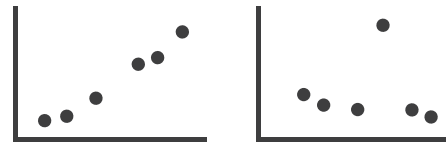


➔ Navigate

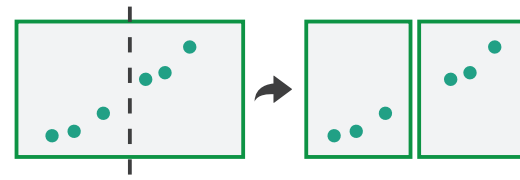


Facet

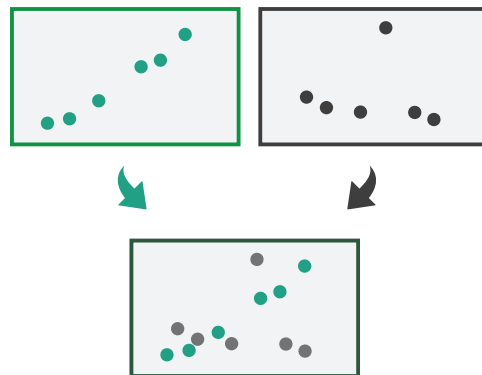
➔ Juxtapose



➔ Partition



➔ Superimpose



Reduce

➔ Filter



➔ Aggregate



➔ Embed

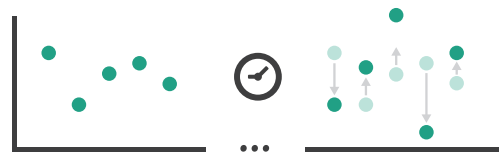


- change view over time
- facet across multiple views
- reduce items/attributes within single view

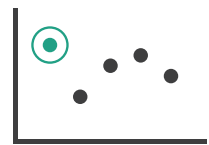
How to handle complexity: 3 more strategies + 1 previous

Manipulate

➔ Change



➔ Select

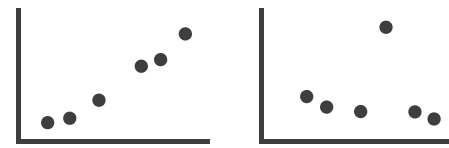


➔ Navigate

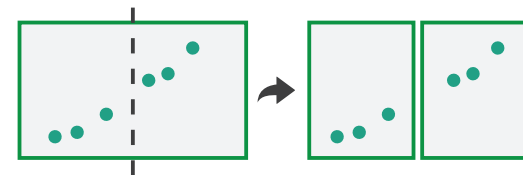


Facet

➔ Juxtapose



➔ Partition



➔ Superimpose

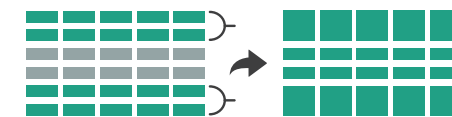


Reduce

➔ Filter



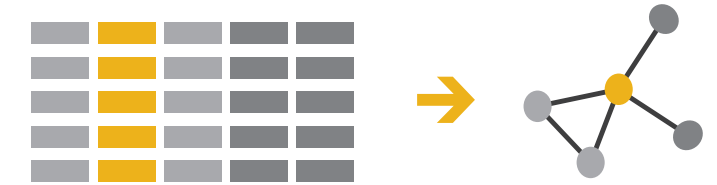
➔ Aggregate



➔ Embed



➔ *Derive*

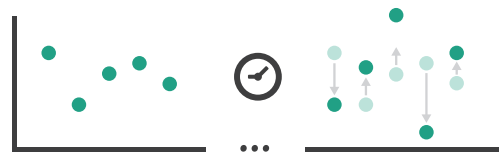


- change view over time
- facet across multiple views
- reduce items/attributes within single view

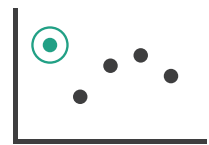
How to handle complexity: 3 more strategies + 1 previous

Manipulate

➔ Change



➔ Select

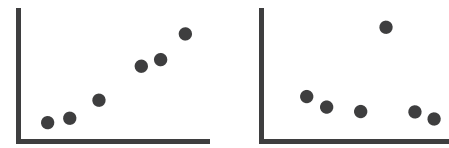


➔ Navigate

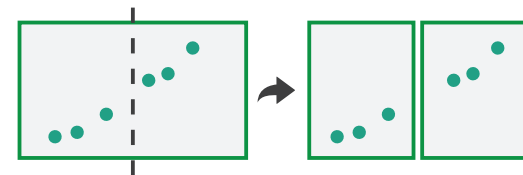


Facet

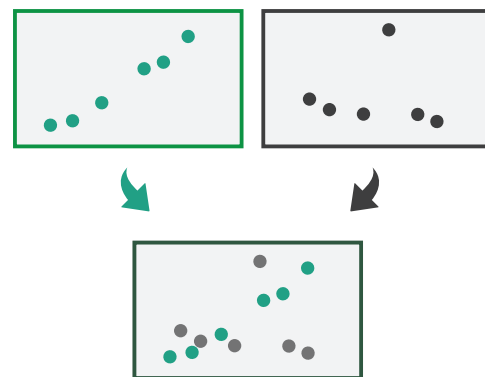
➔ Juxtapose



➔ Partition



➔ Superimpose



Reduce

➔ Filter



➔ Aggregate



➔ Embed



➔ *Derive*



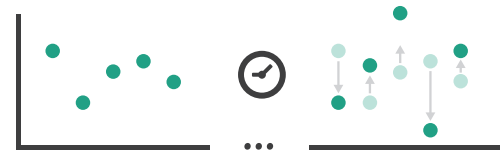
- change view over time
- facet across multiple views
- reduce items/attributes within single view
- derive new data to show within view

How to handle complexity: 3 more strategies

+ 1 previous

Manipulate

→ Change



→ Select

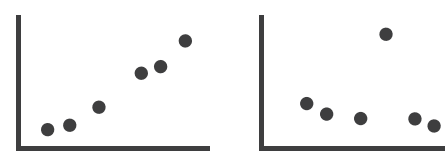


→ Navigate

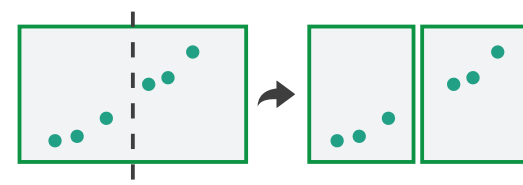


Facet

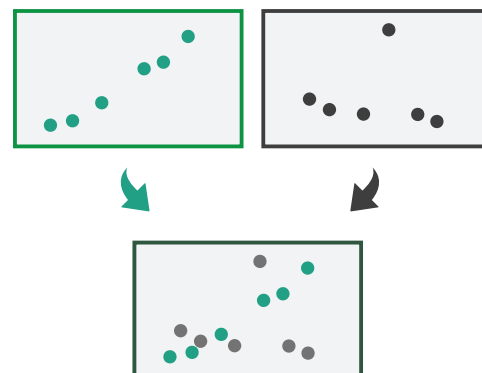
→ Juxtapose



→ Partition



→ Superimpose



Reduce

→ Filter



→ Aggregate



→ Embed



→ *Derive*

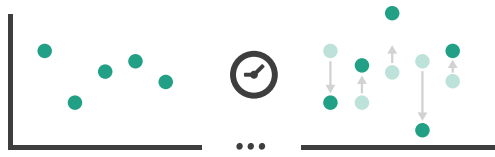


- change over time
- most obvious & flexible of the 4 strategies

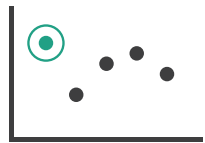
Idiom design choices: Interaction

Manipulate

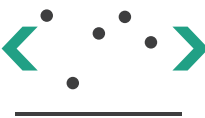
→ Change



→ Select

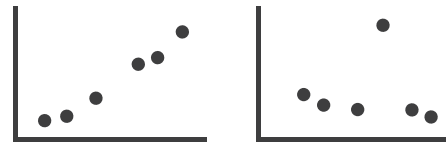


→ Navigate

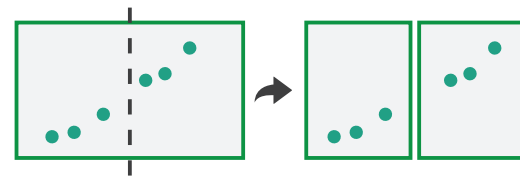


Facet

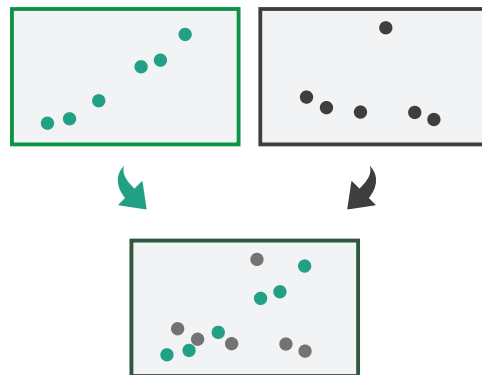
→ Juxtapose



→ Partition



→ Superimpose



Reduce

→ Filter



→ Aggregate



→ Embed



Manipulate

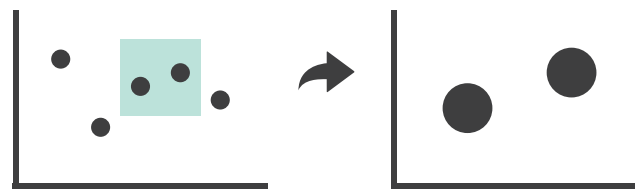
→ Change over Time



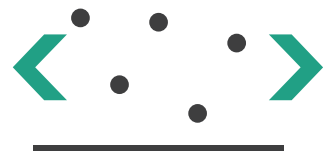
→ Navigate

→ Item Reduction

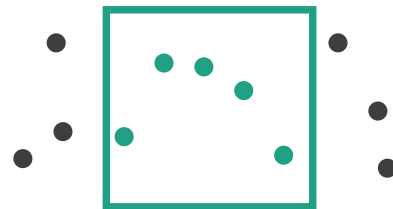
→ *Zoom*
Geometric or *Semantic*



→ *Pan/Translate*

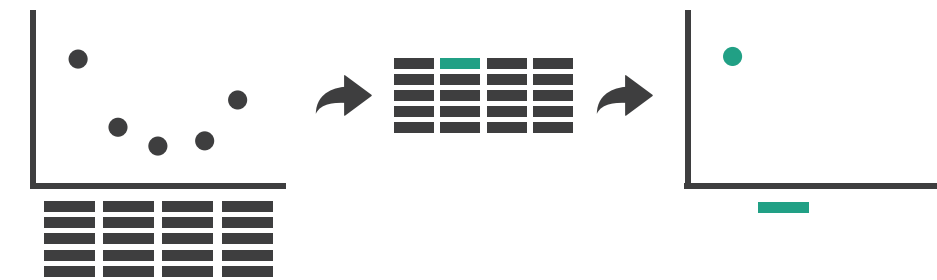


→ *Constrained*

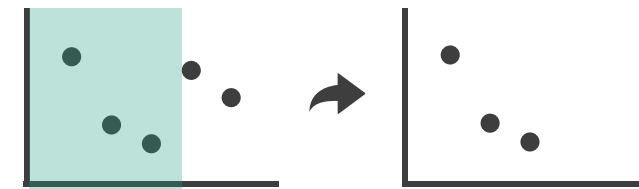


→ Attribute Reduction

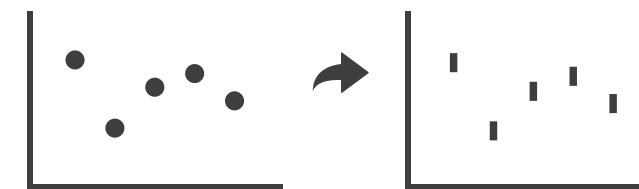
→ *Slice*



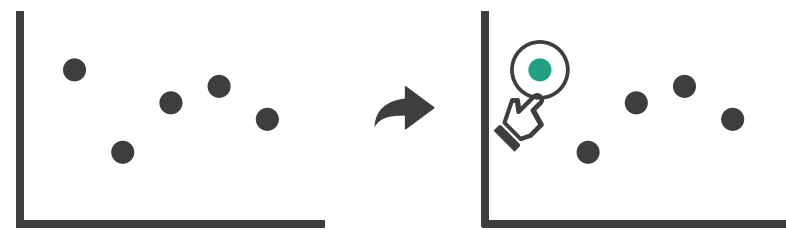
→ *Cut*



→ *Project*



→ Select

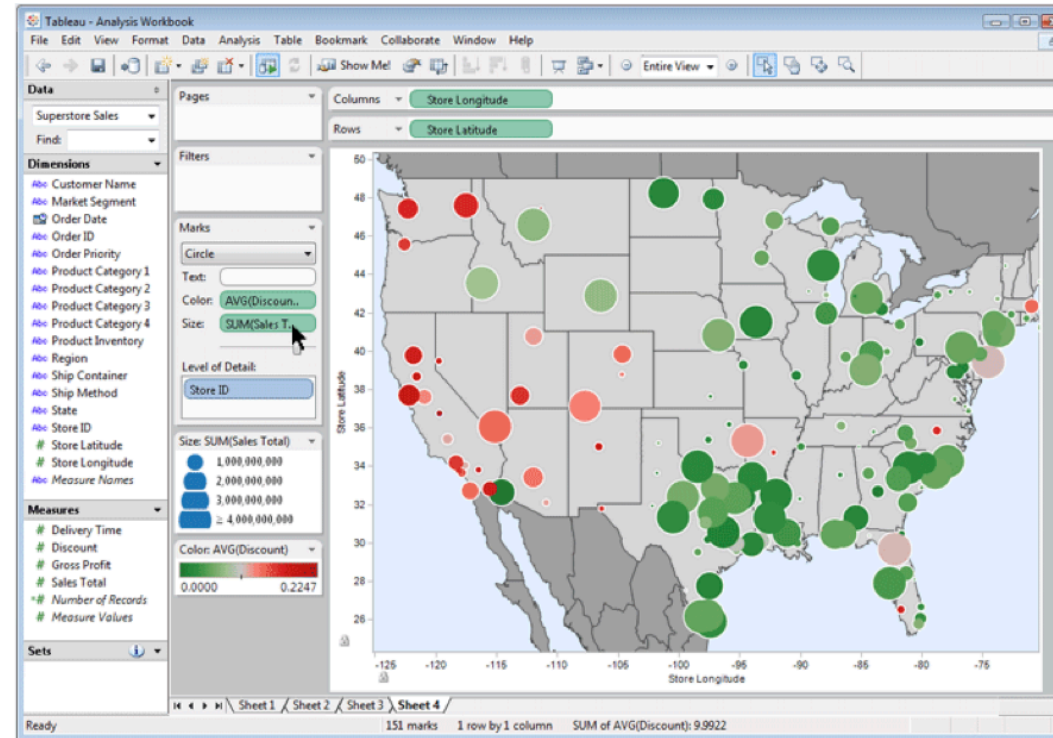
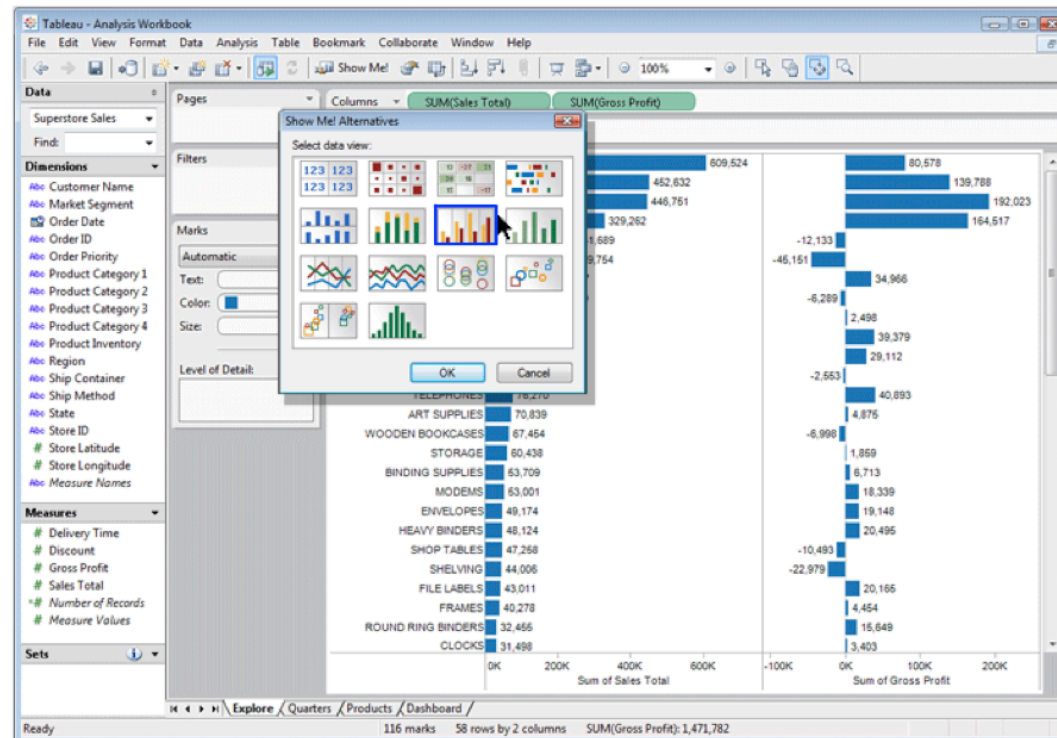
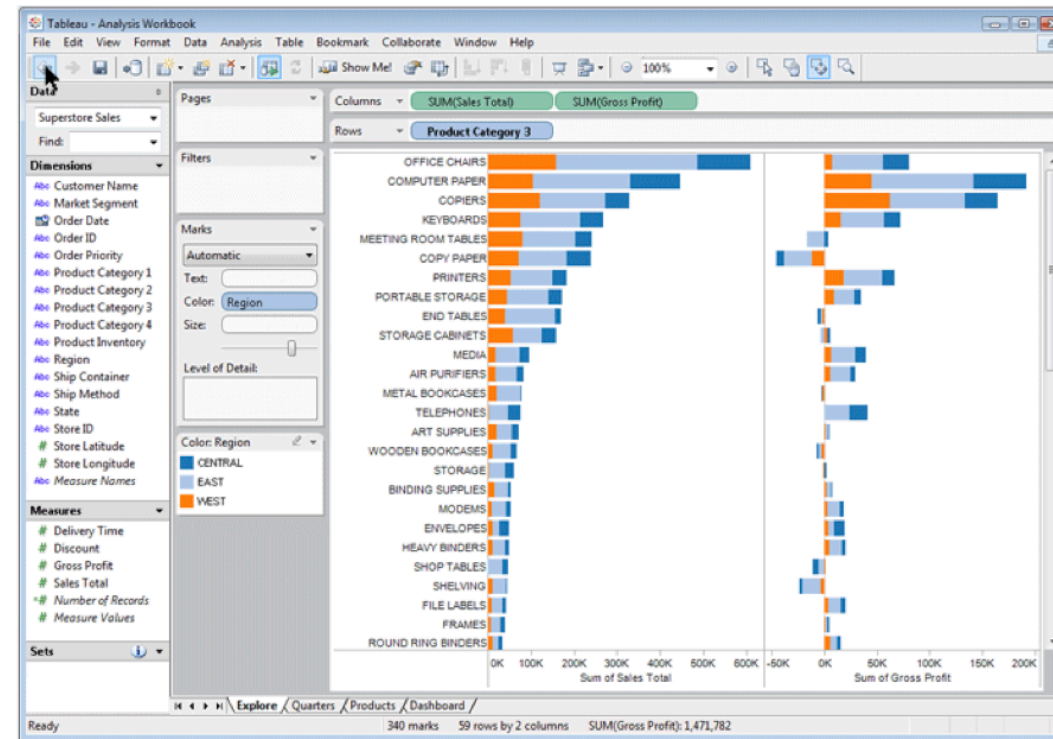
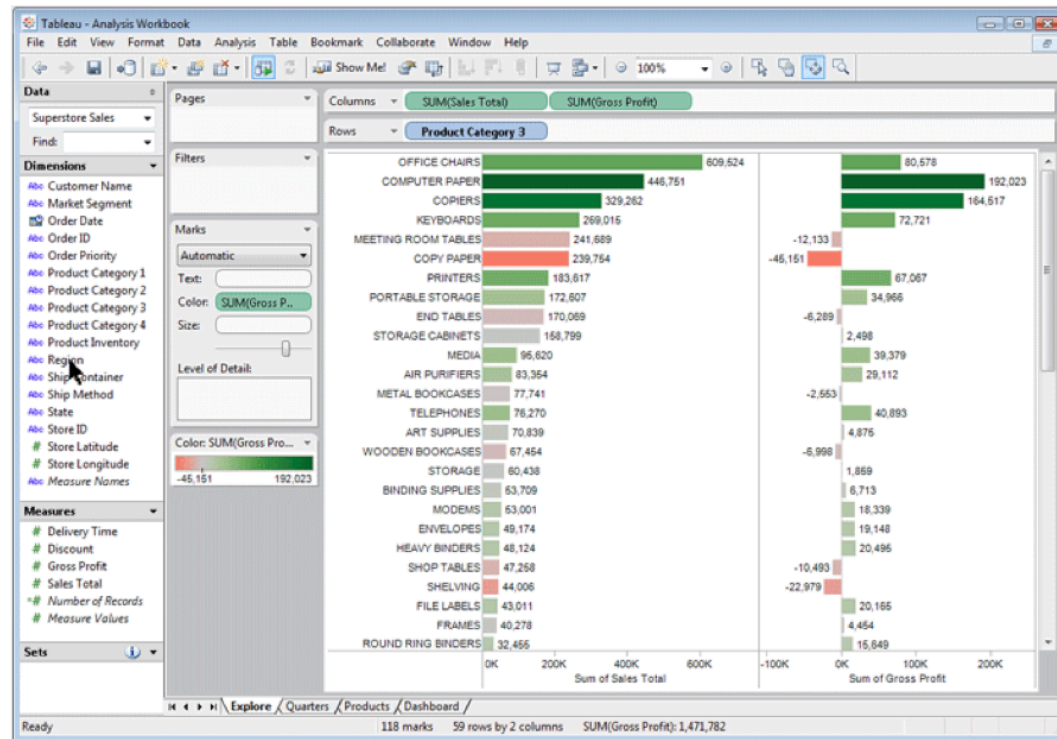


Change over time

- change any of the other choices
 - encoding itself
 - parameters
 - arrange: rearrange, reorder
 - aggregation level, what is filtered...
- why change?
 - one of four major strategies
 - change over time
 - facet data by partitioning into multiple views
 - reduce amount of data shown within view
 - embedding focus + context together
 - most obvious, powerful, flexible
 - interaction entails change

Idiom: Re-encode

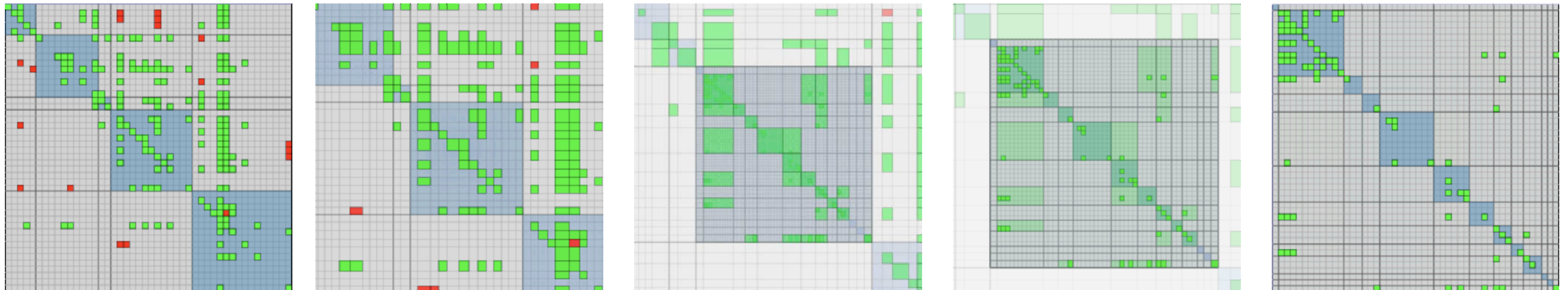
System: Tableau



made using Tableau, <http://tableausoftware.com>

Idiom: **Animated transitions**

- smooth transition from one state to another
 - alternative to jump cuts
 - support for item tracking when amount of change is limited
- example: multilevel matrix views
 - scope of what is shown narrows down
 - middle block stretches to fill space, additional structure appears within
 - other blocks squish down to increasingly aggregated representations

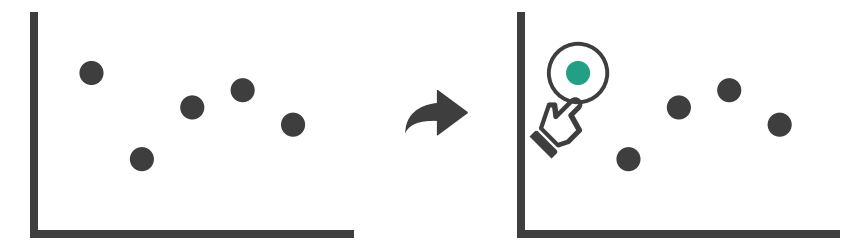


[Using Multilevel Call Matrices in Large Software Projects. van Ham. Proc. IEEE Symp. Information Visualization (InfoVis), pp. 227–232, 2003.]

Select and highlight

- selection: basic operation for most interaction
- design choices
 - how many selection types?
 - click vs hover: heavyweight, lightweight
 - primary vs secondary: semantics (eg source/target)
- highlight: change visual encoding for selection targets
 - color
 - limitation: existing color coding hidden
 - other channels (eg motion)
 - add explicit connection marks between items

➔ Select



Navigate: Changing item visibility

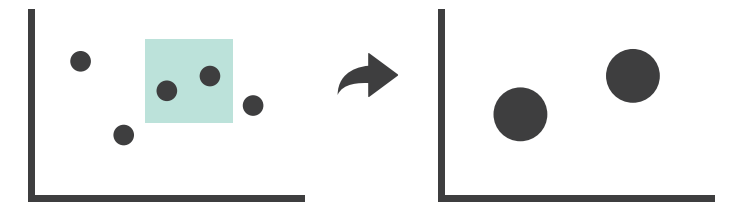
- change viewpoint
 - changes which items are visible within view
 - camera metaphor
 - zoom
 - geometric zoom: familiar semantics
 - semantic zoom: adapt object representation based on available pixels
 - » dramatic change, or more subtle one
 - pan/translate
 - rotate
 - especially in 3D
 - constrained navigation
 - often with animated transitions
 - often based on selection set

➔ Navigate

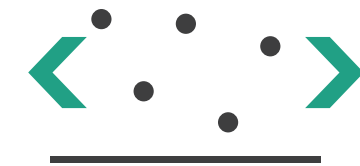
➔ Item Reduction

➔ Zoom

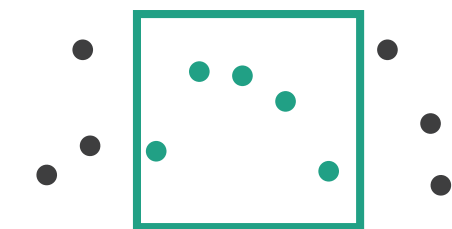
Geometric or *Semantic*



➔ Pan/Translate



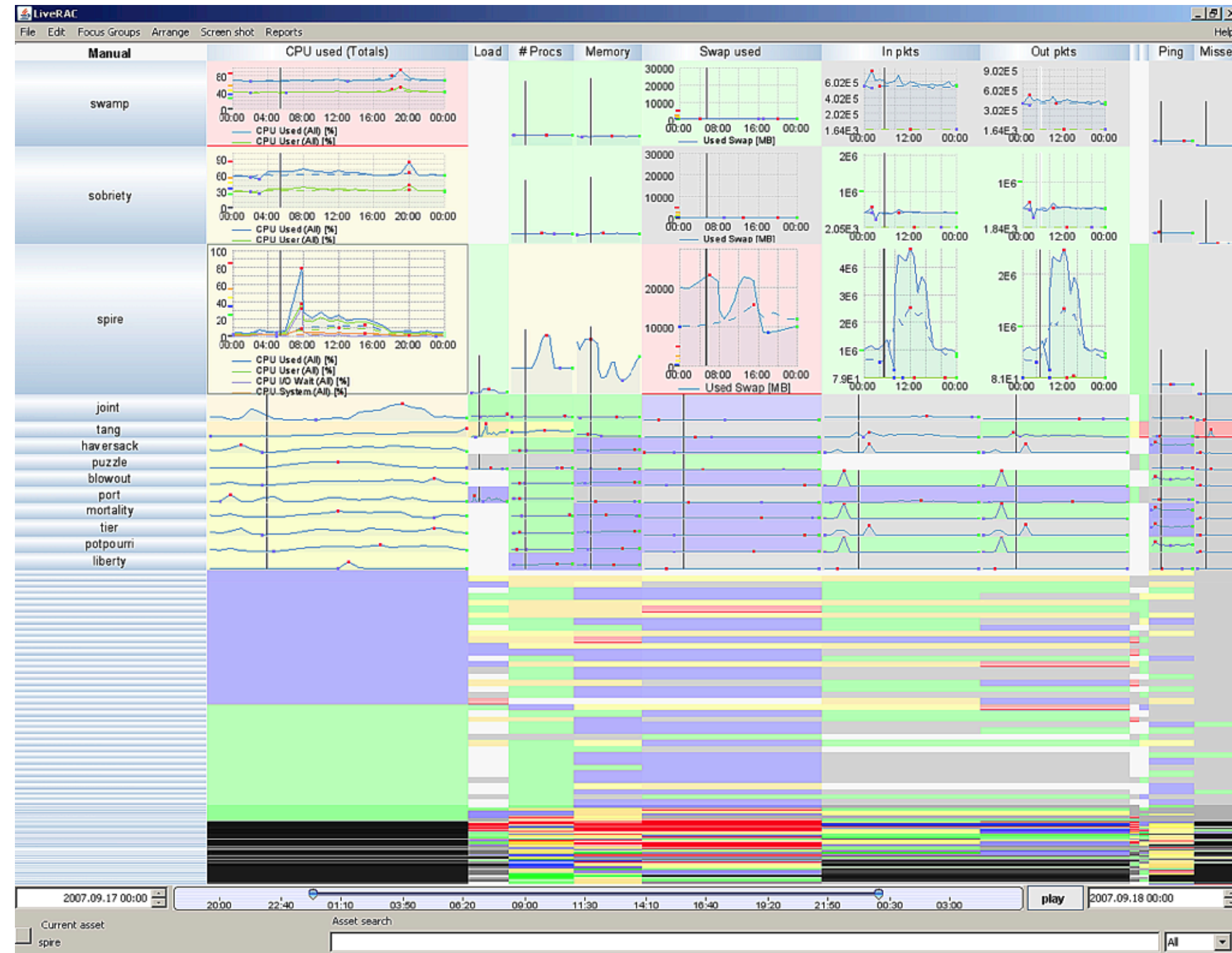
➔ Constrained



Idiom: Semantic zooming

System: **LiveRAC**

- visual encoding change
 - colored box
 - sparkline
 - simple line chart
 - full chart: axes and tickmarks



[LiveRAC - Interactive Visual Exploration of System Management Time-Series Data. McLachlan, Munzner, Koutsofios, and North. Proc. ACM Conf. Human Factors in Computing Systems (CHI), pp. 1483–1492, 2008.]