Universitat de Girona
Fundació UdG: Innovació i Formació

Visualization for Transparency Foundation

MVTEC

Data Visualization Programming Anton Bardera Data Visualization Programming Anton Bardera Data Visualization Programming Anton Bardera **Data Visualization Programming** Anton Bardera Data Visualization Programming Anton Bardera Data Visualization Programming Anton Bardera Data Visualization Programming Anton Bardera Data Visualization Programming Anton Bardera Data Visualization

Visual Encoding

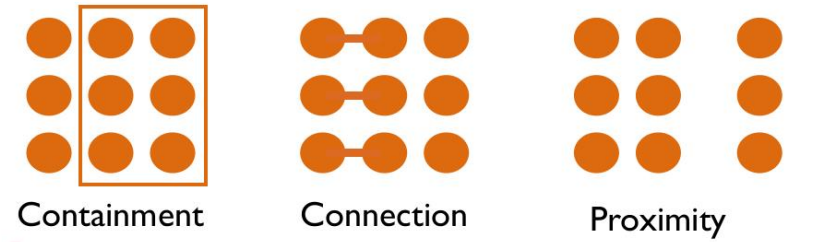
- The way in which data is mapped into visual structures, upon which we build the images on a screen
- Items or links are represented using **marks** or geometrical primitives
- The changes on the mark's appearance based on a data attribute are called **channels**

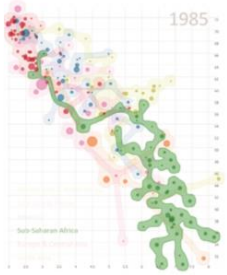
Channel = Visual Variable

Marks

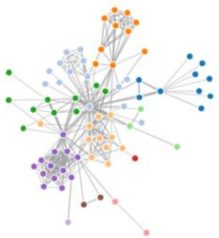
- Marks for Items: basic geometric elements
  - Points
  - Lines
  - Areas
  - Volume: rarely used

- Marks for Links
  - Containment
  - Connection
  - Proximity

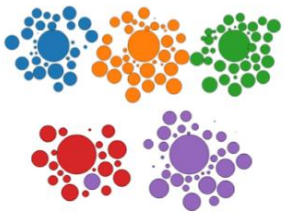




Collins et al. 2009

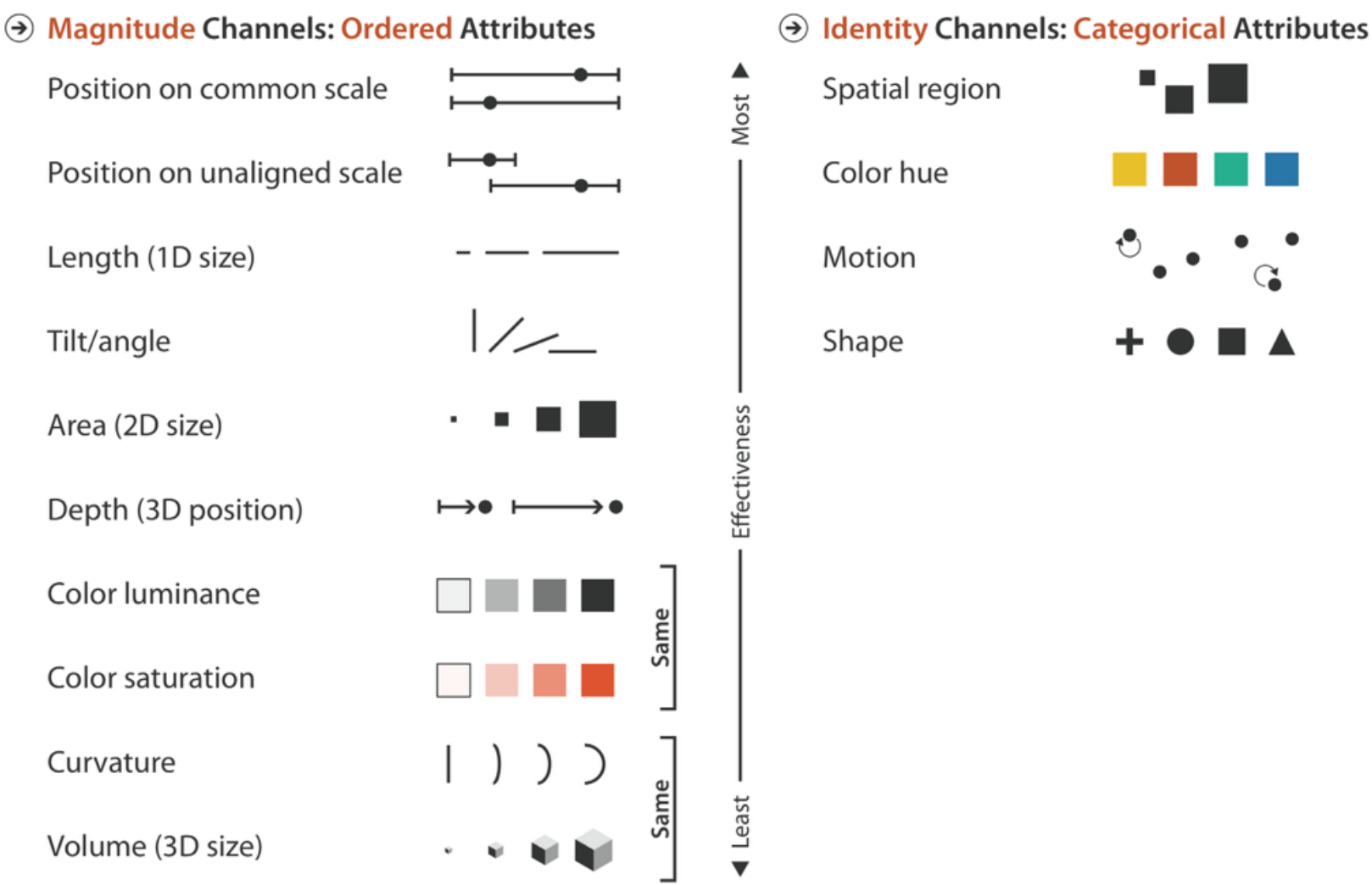


D3.js Example



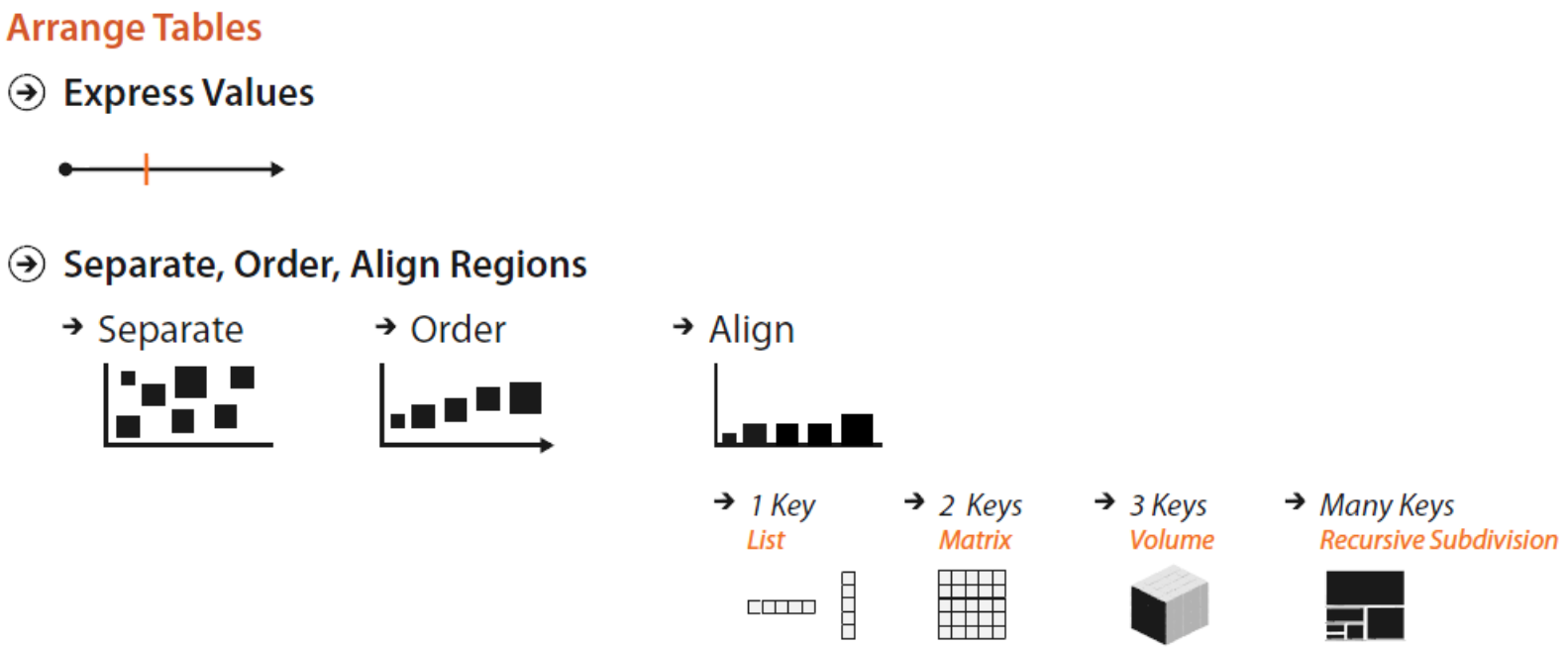
D3.js Example

Visual attributes' effectiveness



[From Tamara Munzer, Visualization Analysis and Design, 2014]

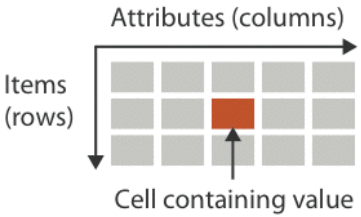
Arrange tables



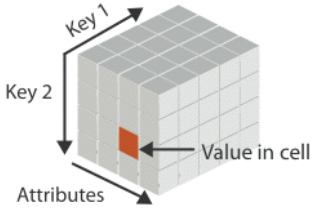
[From Tamara Munzer, Visualization Analysis and Design, 2014]

Dataset types

- Structured Data: known data types, semantics
  - Tables



➔ *Multidimensional Table*



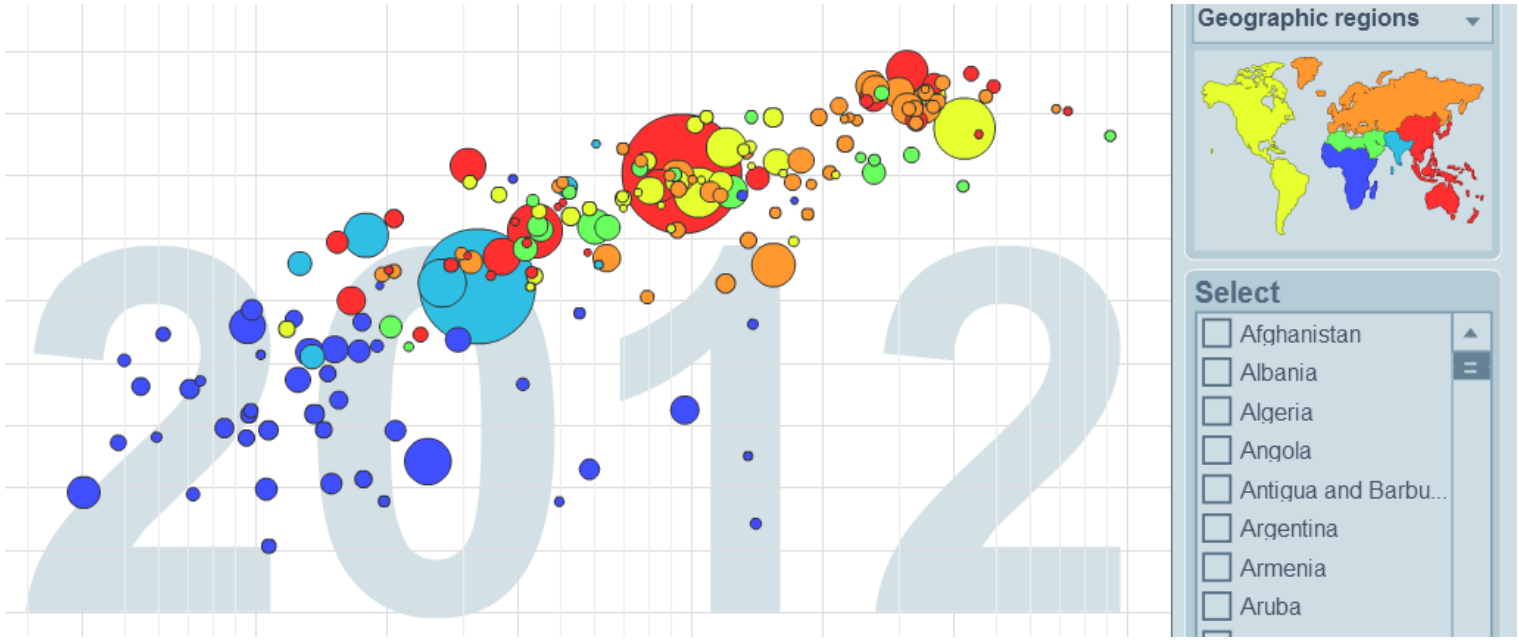
- Depending on the number and type of keys and the number of attributes, different techniques are used

Arrange tables

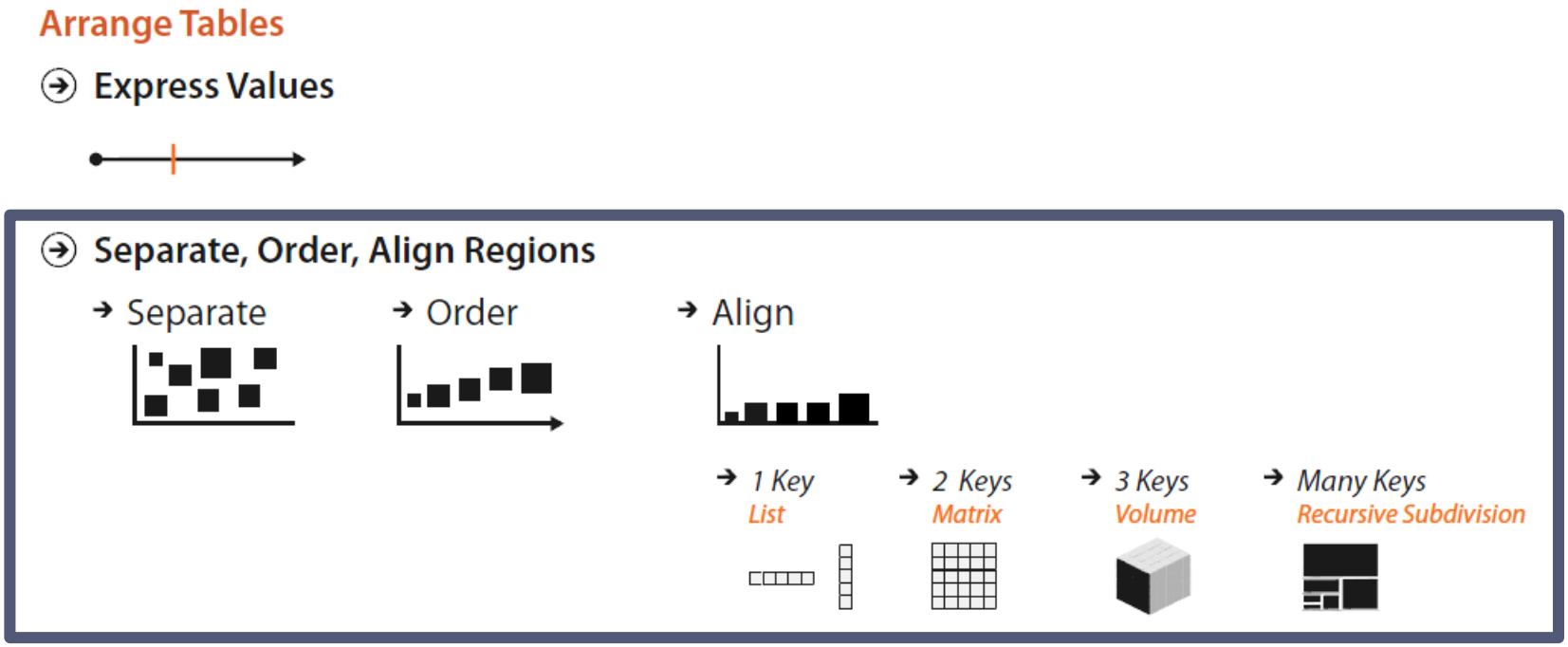
[From Tamara Munzer, Visualization Analysis and Design, 2014]

Scatterplot

Idiom	Scatterplots
What: Data	Table: two quantitative value attributes.
How: Encode	Express values with horizontal and vertical spatial position and point marks.
Why: Task	Find trends, outliers, distribution, correlation; locate clusters.
Scale	Items: hundreds.



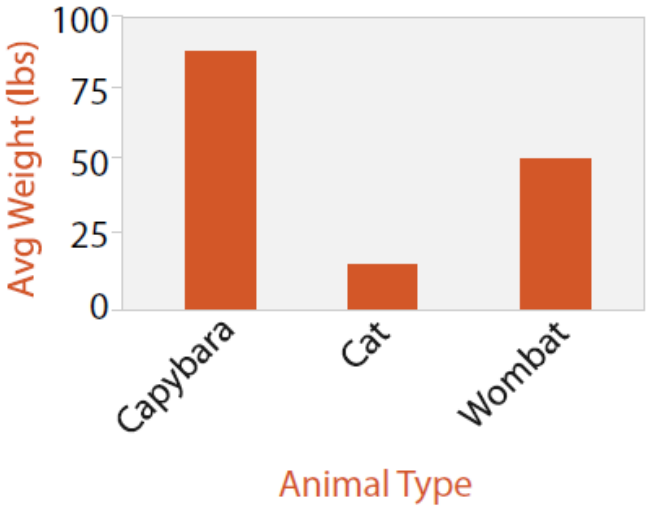
Arrange tables

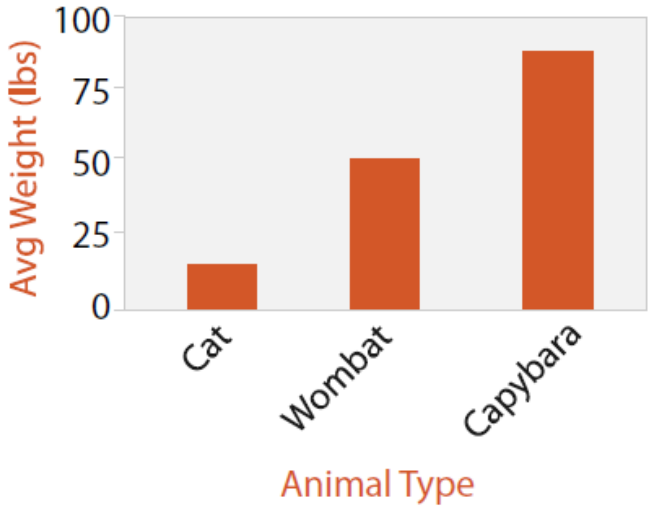


[From Tamara Munzer, Visualization Analysis and Design, 2014]

Bar chart

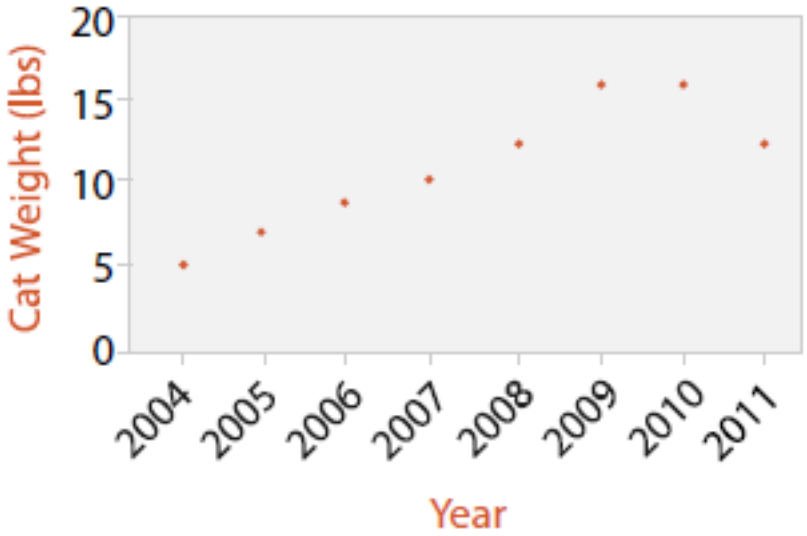
Idiom	Bar Charts
What: Data	Table: one quantitative value attribute, one categorical key attribute.
How: Encode	Line marks, express value attribute with aligned vertical position, separate key attribute with horizontal position.
Why: Task	Lookup and compare values.
Scale	Key attribute: dozens to hundreds of levels.





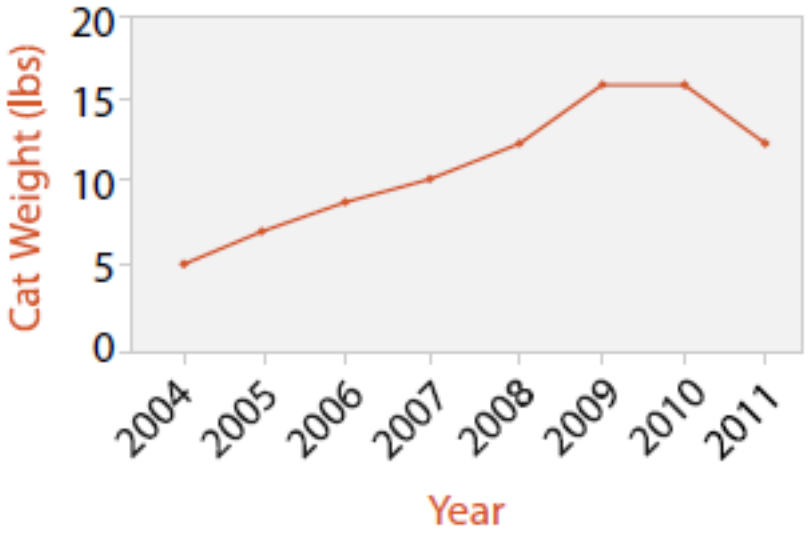
Dot chart

Idiom	Dot Charts
What: Data	Table: one quantitative value attribute, one ordered key attribute.
How: Encode	Express value attribute with aligned vertical position and point marks. Separate/order into horizontal regions by key attribute.



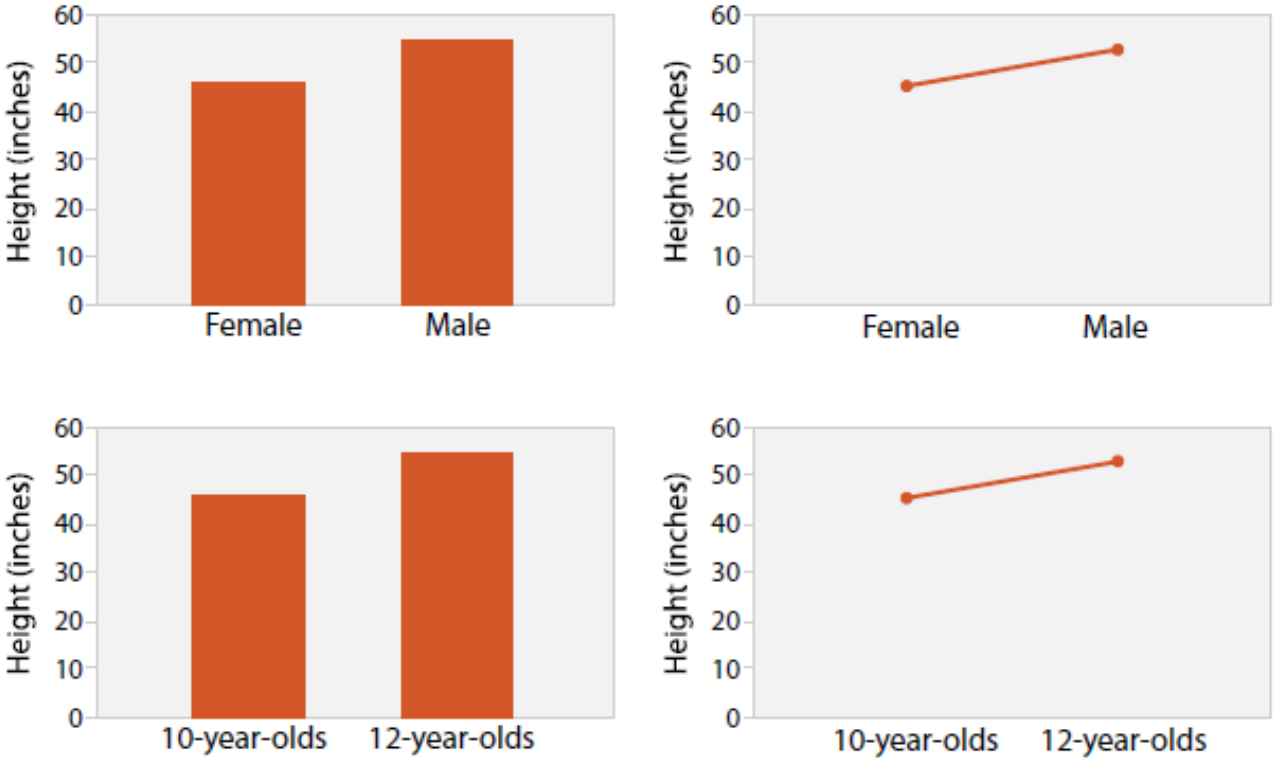
Line chart

Idiom	Line Charts
What: Data	Table: one quantitative value attribute, one ordered key attribute.
How: Encode	Dot chart with connection marks between dots.
Why	Show trend.
Scale	Key attribute: hundreds of levels.



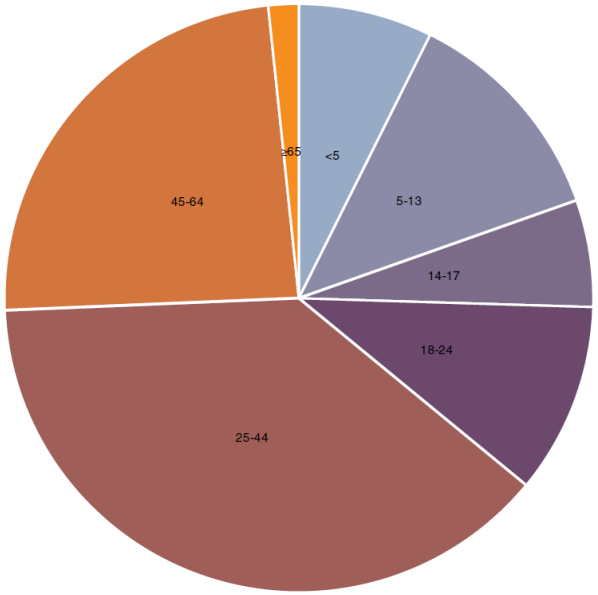
Bar chart *vs* line chart

- Bar charts: discrete comparisons
- Line graphs: trend assessments



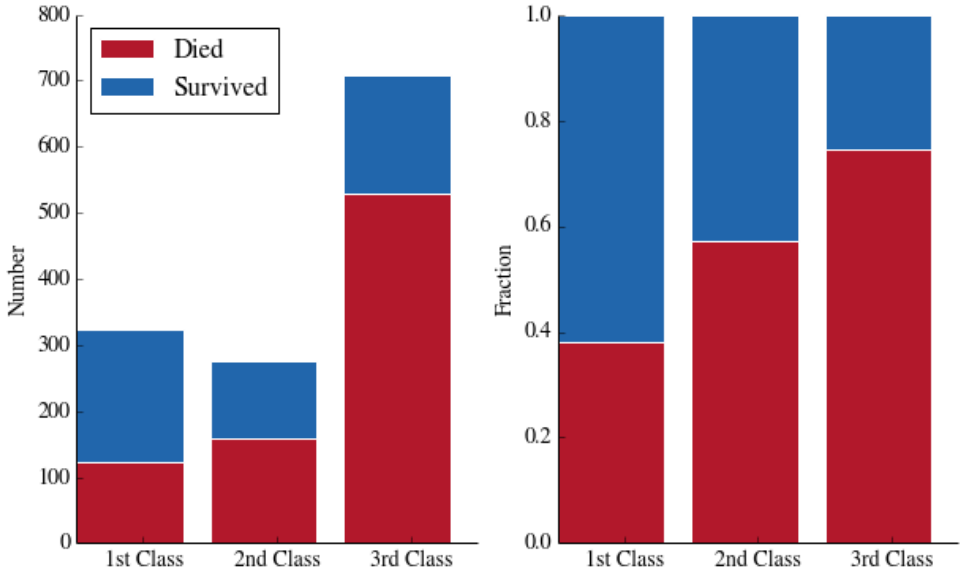
Pie chart

Idiom	Pie Charts
What: Data	Table: one quantitative attribute, one categorical attribute.
Why: Task	Part–whole relationship.
How: Encode	Area marks (wedges) with angle channel; radial layout.
Scale	One dozen categories.



Stacked bar chart

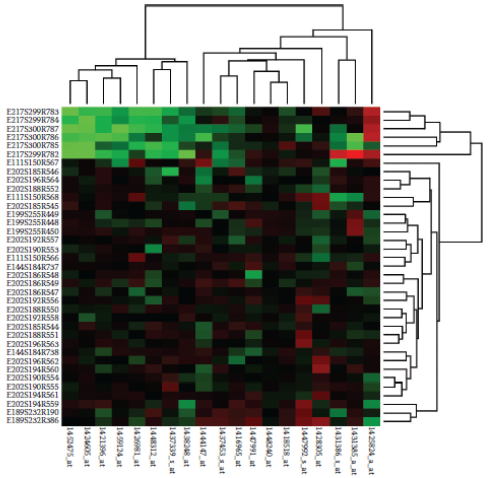
Idiom	Stacked Bar Charts
What: Data	Multidimensional table: one quantitative value attribute, two categorical key attributes.
How: Encode	Bar glyph with length-coded subcomponents of value attribute for each category of secondary key attribute. Separate bars by category of primary key attribute.
Why: Task	Part-to-whole relationship, lookup values, find trends.
Scale	Key attribute (main axis): dozens to hundreds of levels. Key attribute (stacked glyph axis): several to one dozen



Heat maps

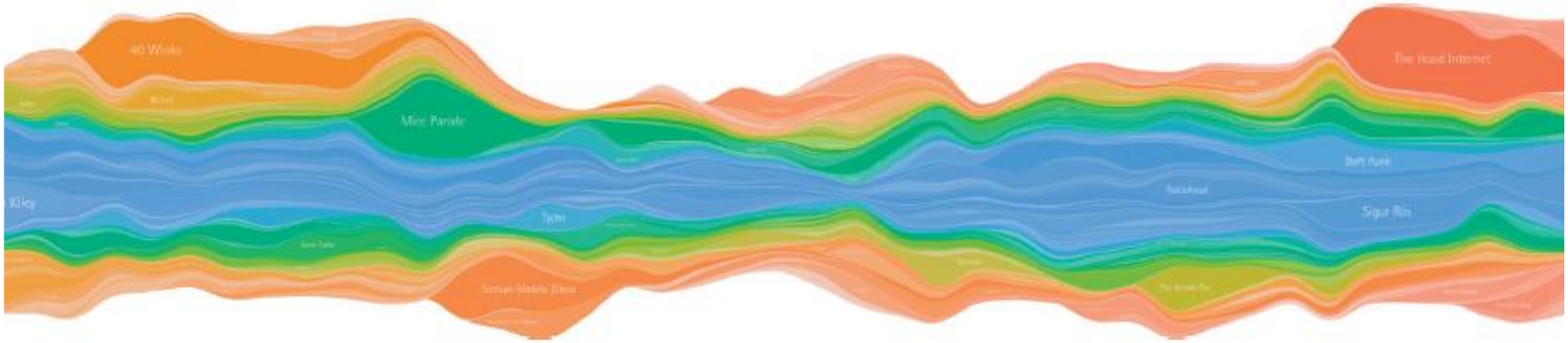
Idiom	Heatmaps
What: Data	Table: two categorical key attributes (genes, conditions), one quantitative value attribute (activity level for gene in condition).
How: Encode	2D matrix alignment of area marks, diverging colormap.
Why: Task	Find clusters, outliers; summarize.
Scale	Items: one million. Categorical attribute levels: hundreds. Quantitative attribute levels: 3–11.

Idiom	Cluster Heatmaps
What: Derived	Two cluster hierarchies for table rows and columns.
How: Encode	Heatmap: 2D matrix alignment, ordered by both cluster hierarchies. Dendrogram: connection line marks for parent–child relationships in tree.



Streamgraph

Idiom	Streamgraphs
What: Data	Multidimensional table: one quantitative value attribute (counts), one ordered key attribute (time), one categorical key attribute (artist).
What: Derived	One quantitative attribute (for layer ordering).
How: Encode	Use derived geometry showing artist layers across time, layer height encodes counts.
Scale	Key attributes (time, main axis): hundreds of time points. Key attributes (artists, short axis): dozens to hundreds



Star plot

- Encode categorical variables using the angle and a numerical data with the radius (polar coordinates)
- They can be used to represent data with periodical patterns (typical in temporal data)