MVT EC

Data Visualization Programming Anton Bardera **Data Visualization Programming** Anton Bardera **Data Visualization Programming** Anton Bardera **Data Visualization Program-ming** 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**
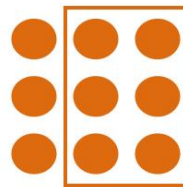 - Points
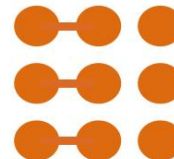 - Lines
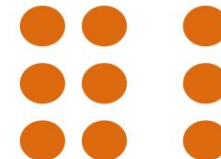 - Areas
  - Volume: rarely used

- **Marks for Links**
  - Containment
  - Connection
  - Proximity

Containment   Connection   Proximity
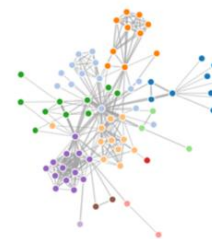
Collins et al. 2009   D3.js Example   D3.js Example
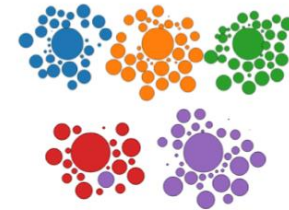
Channels

- Control appearance proportional to or based on attributes

[From Tamara Munzer, Visualization Analysis and Design, 2014]
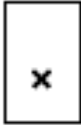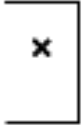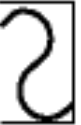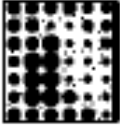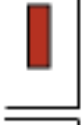
Bertin's Visual Attributes

[From Jacques Bertin, *Semiology of Graphics*, 1967]

Visual attributes' effectiveness

Magnitude Channels: Ordered Attributes

- Position on common scale
- Position on unaligned scale
- Length (1D size)
- Tilt/angle
- Area (2D size)
- Depth (3D position)
- Color luminance
- Color saturation
- Curvature
- Volume (3D size)

Most → Least Effectiveness

Same / Same

Identity Channels: Categorical Attributes

- Spatial region
- Color hue
- Motion
- Shape

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

Position

- Strongest visual variable
- Suitable for all data types
- Problems:
  - Sometimes not available (spatial data)
  - Cluttering

[http://www.nytimes.com/interactive/2009/03/01/business/20090301_WageGap.html]
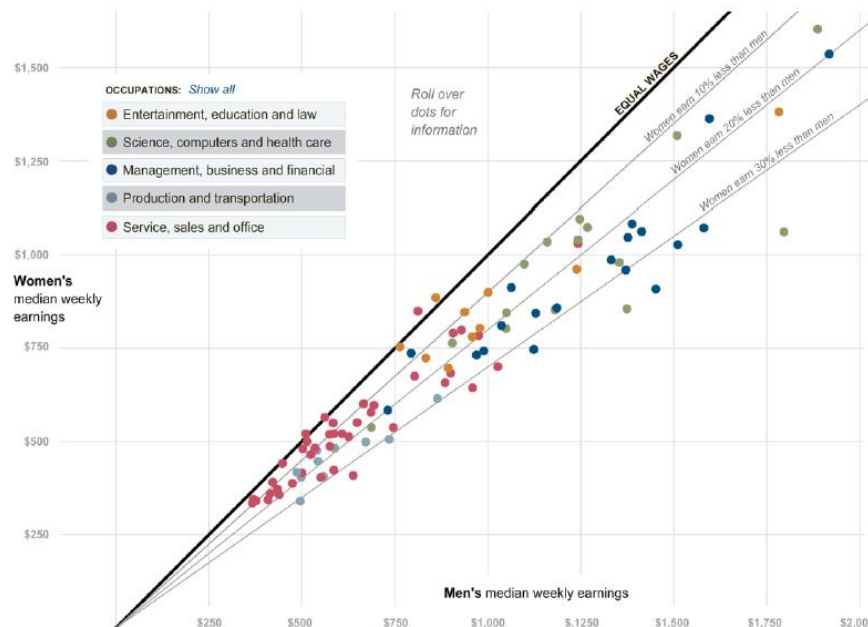
Length and Size

- Good for 1D, OK for 2D, Bad for 3D
- Easy to see whether one is bigger
- Aligned bars use position redundantly

Four Ways to Slice Obama's 2013 Budget Proposal

Explore every nook and cranny of President Obama's federal budget proposal.

[http://www.nytimes.com/interactive/2012/02/13/us/politics/2013-budget-proposal-graphic.html?_r=0]
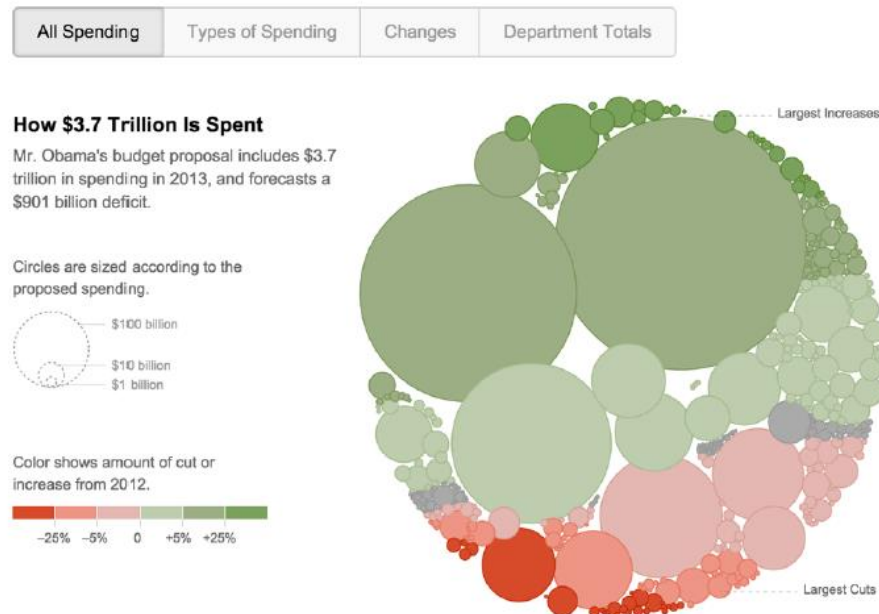
Angle and tilt

- OK for qualitative data
- Limited number of classes
- Difficult to compare
- Does not work for quantitative data!
- Pie charts are not recommended

Angle and tilt
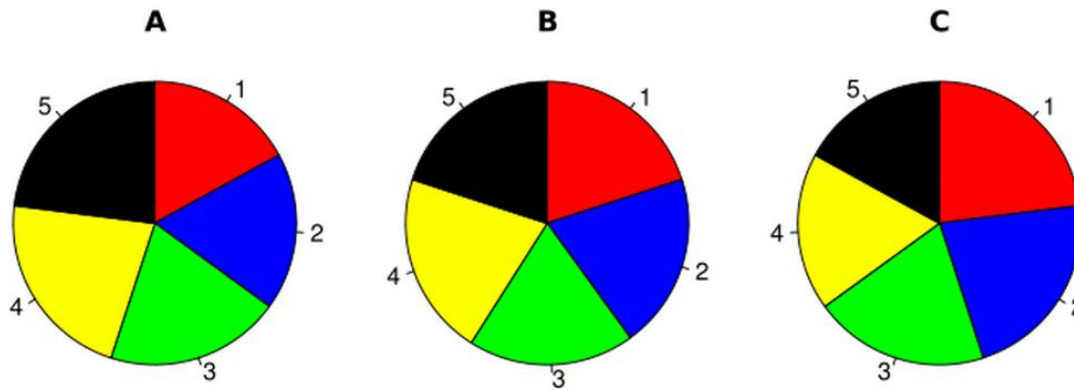
Angle and tilt

Shape

- Great to recognize many classes
- No grouping, ordering

Color

- Value/Luminance/Saturation
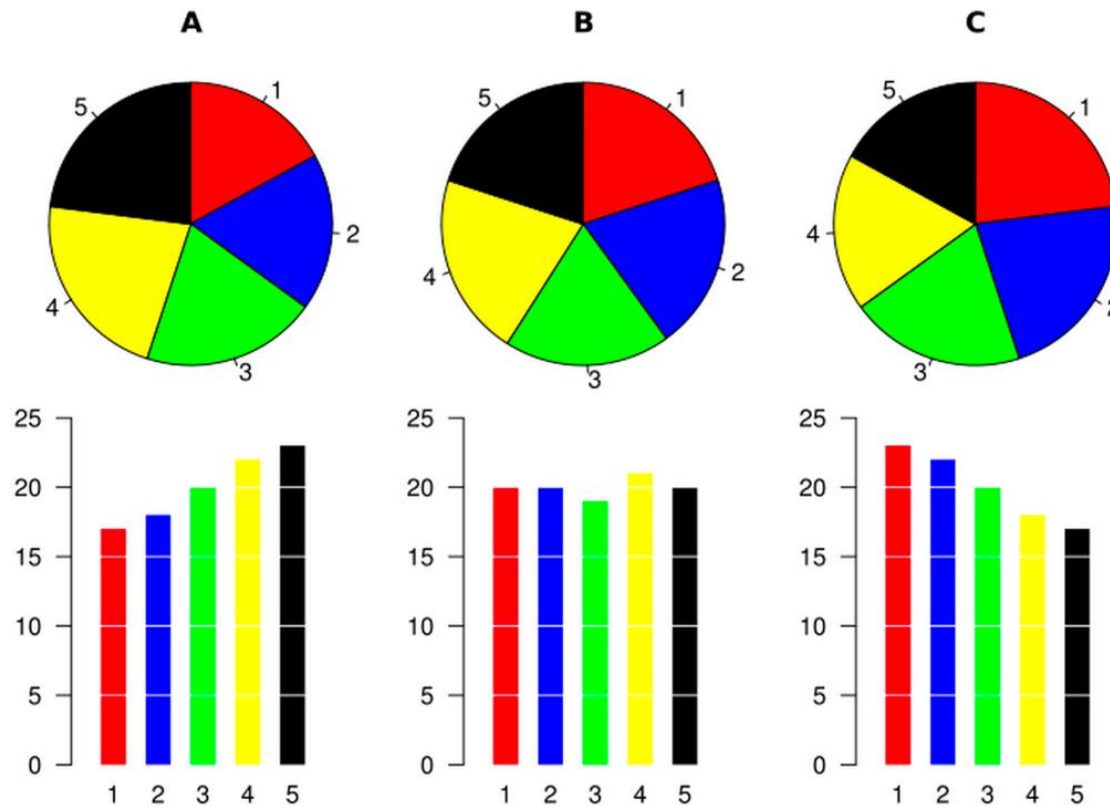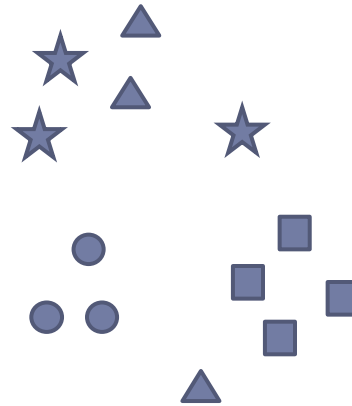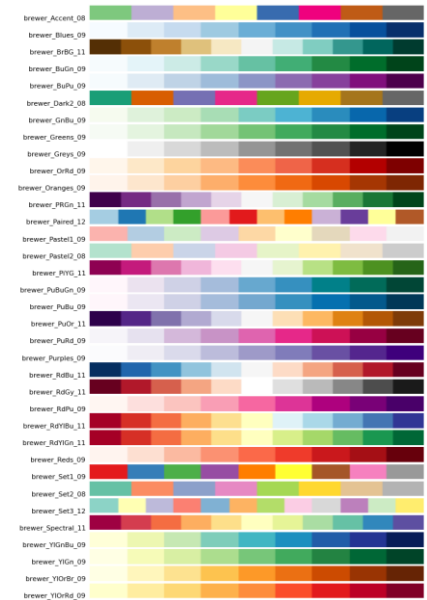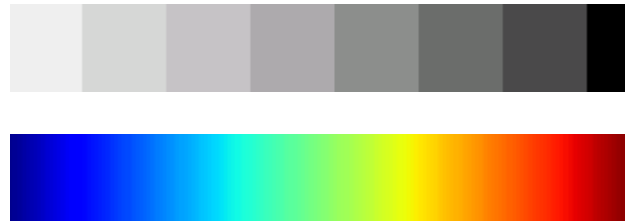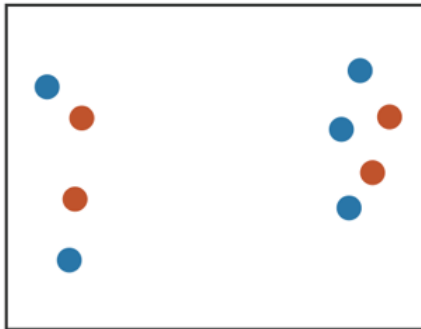 - OK for quantitative data when length & size are used
  - Not very many shades recognizable
- Hue
  - Good for qualitative data
  - Limited number of classes/length
  - Does not work for quantitative data!
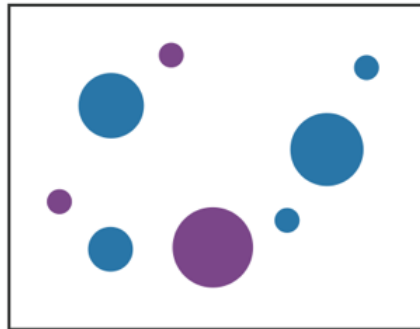
Separability of Attributes

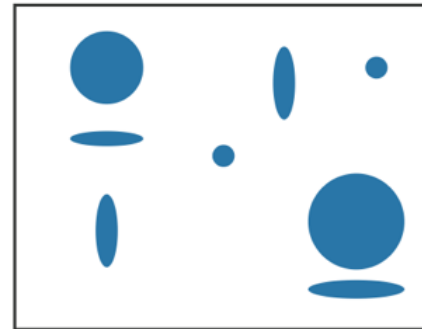- Can we combine multiple visual variables?

Position + Hue (Color) — Fully separable

Size + Hue (Color) — Some interference

Width + Height — Some/significant interference

Red + Green — Major interference