Visual Symbols

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Symbols and Visualization

- The patterns and relationships discovery start by mapping data into graphical symbols

SOME SIMPLE RULES:

- Any screen pattern should imply into a data pattern, otherwise it is an artifact
- Any order perceived in the visual representation should reflect some data property
- Similarity between data instances should imply similarity between the visual symbols representing them

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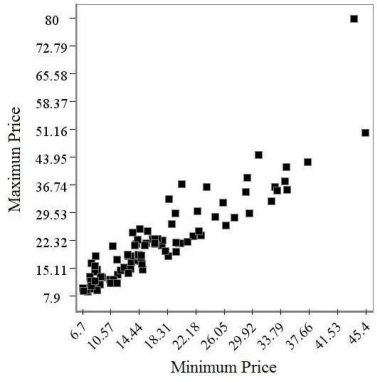
The Eight Visual Variables

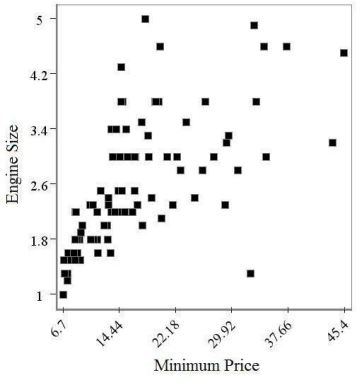
- A common way to translate data into visual representations is to map each data attribute into a different visual marker

- It is possible to use up to eight visual variables
  1. Position
  2. Shape
  3. Size
  4. Brightness
  5. Color
  6. Orientation
  7. Texture
  8. Movement

Position

- Position (1D, 2D, or 3D) is the most important variable
  - Spatial arrangement is the first to be read on a visualization

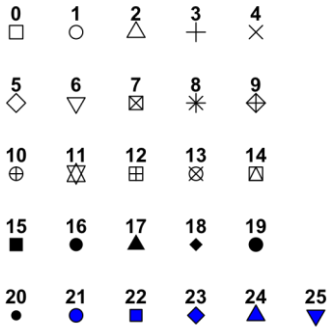




Shape

- Any graphical element can be used as a marker, including symbols, letters and words

In R the shapes are:



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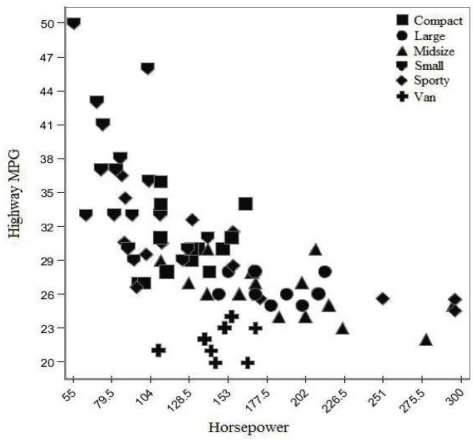
Shape

- Markers should be as different as possible between themselves but with similar area and complexities



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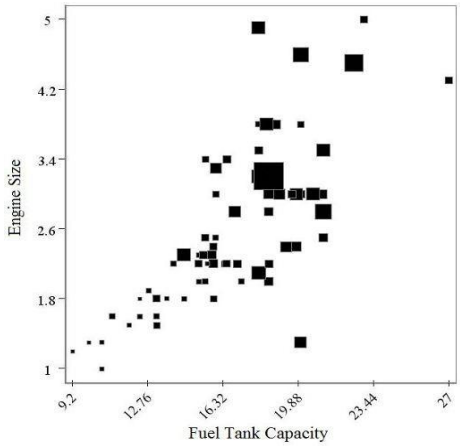
Size (length, area and volume)

- Position and shape are the most important variables, the other only affect the way these are displayed, e.g., changing the size of the markers

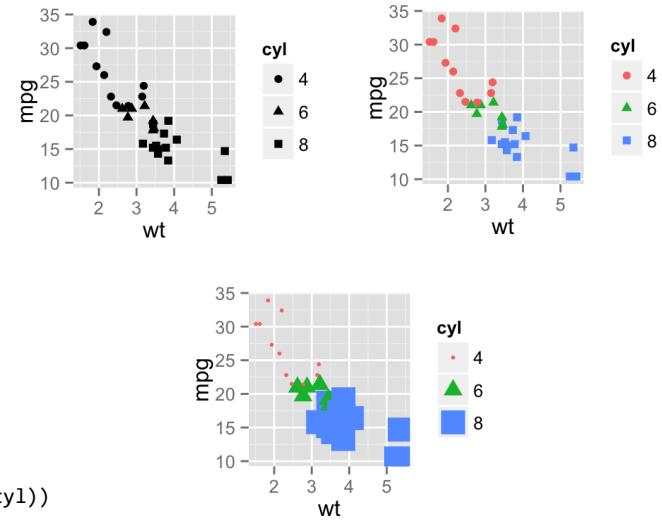
Size (length, area, and volume)

- Size can be used to map continuous and categorical variables, but for the second case only few categories can be considered



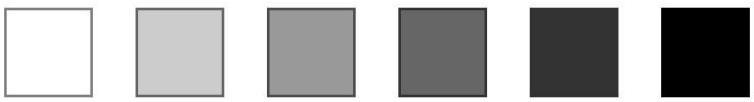
Examples:

```
library(ggplot2)

# Scatter plot with multiple groups
# Shape depends on cyl
ggplot(df, aes(x=wt, y=mpg, group=cyl)) +
  geom_point(aes(shape=cyl))

# Change point shapes and colors
ggplot(df, aes(x=wt, y=mpg, group=cyl)) +
  geom_point(aes(shape=cyl, color=cyl))

# change point shapes,  colors and sizes
ggplot(df, aes(x=wt, y=mpg, group=cyl)) +
  geom_point(aes(shape=cyl, color=cyl, size=cyl))
```

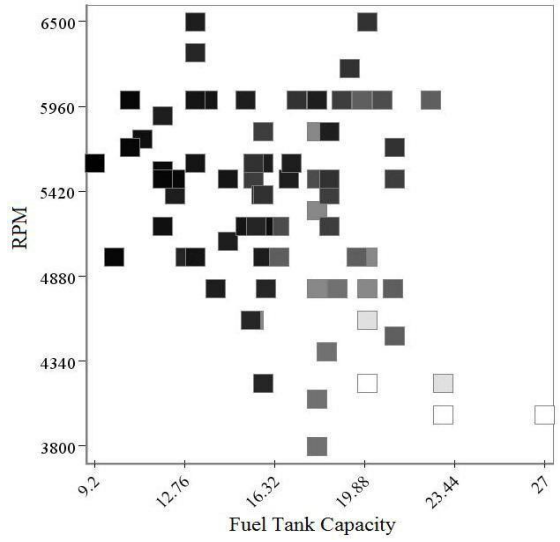


Brightness

- Brightness can be used for continuous attributes, but only a few categorical values can be distinguished by humans



Brightness



Brightness is car size

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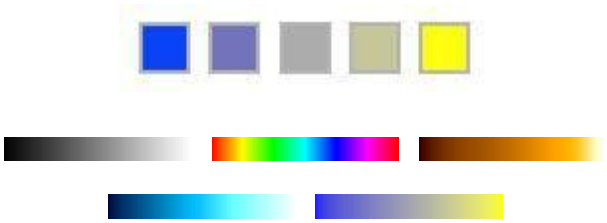
Color

- Values are mapped to colors normally using a colormap
  - There are specific colormaps for continuous and categorical values (but only few classes)



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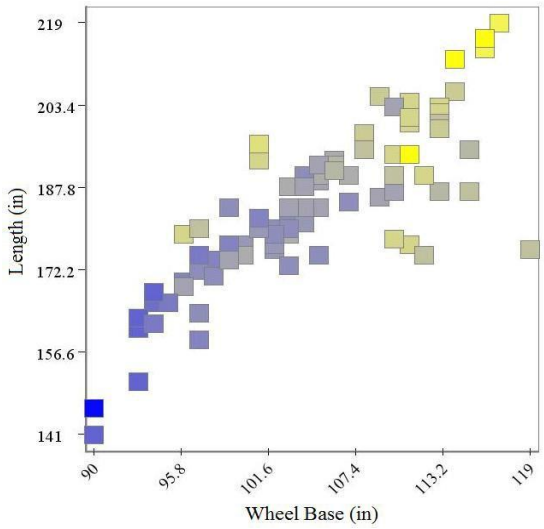
Color



Color is car size

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Orientation

- Orientation or direction is pre-attentively processed
  - Cannot be used for all markers, problems with more than one natural axis

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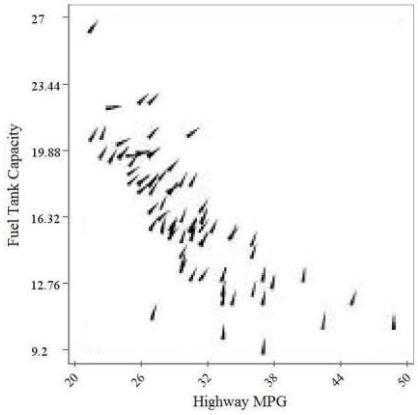
Orientation



Orientation is price average

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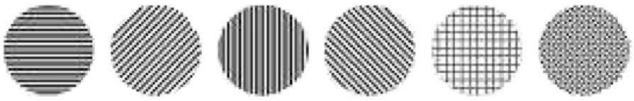
Texture

- Texture can be understood as a combination of other variables, such as shape, color and orientation



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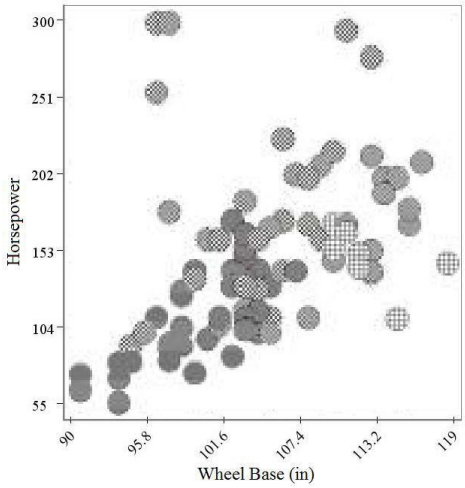
Texture



Texture is type of car (SUV, compact, etc)

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Movement

- Movement can be associated with other visual variables
  - Important to indicate temporal variation

- Read suggestion:
  - G. Robertson, R. Fernandez, D. Fisher, B. Lee, J. Stasko. **Effectiveness of Animation in Trend Visualization**. *IEEE Transactions on Visualization and Computer Graphics*, vol. 14, no. 6, pp. 1325-1332, November/December, 2008

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