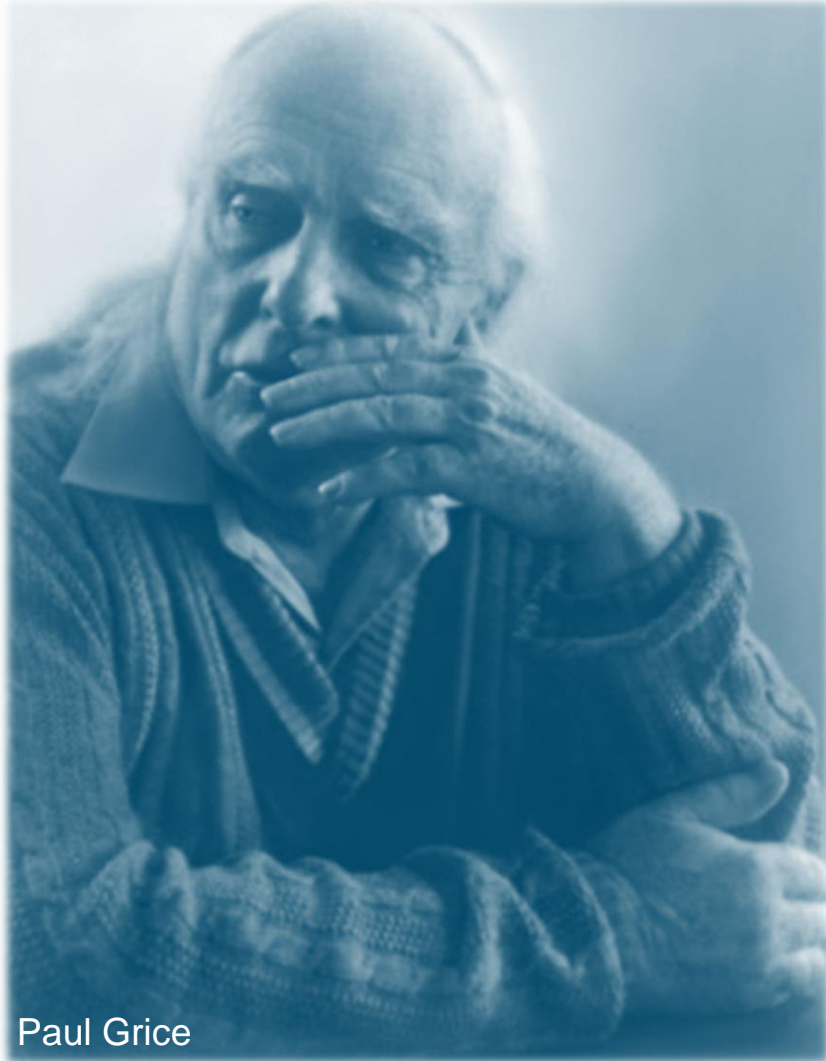# Data Visualization

design effective data visualizations

Images

Why do we visualize data?

Paul Grice

Be informative

- Make your contribution **as informative as is required**.

- Do **not** make your contribution **more informative than is required**.

Be truthful

- Do **not** say what you believe **to be false**.

- Do **not** say that for which you **lack evidence**.

Be clear

- Avoid **obscurity** of expression.

- Avoid **ambiguity**.

- Be **brief**.

- Be **orderly**.

Be relevant

- Make sure that all the information is **relevant** to the current exchange.

Why do we visualize data?

Jock Mackinlay

Expressiveness

if the **relevant information** of a dataset is expressed by the visualization, and **only this**.

Effectiveness

a visualization addresses the **capabilities** of the **human visual system**: it's **easier to understand**.

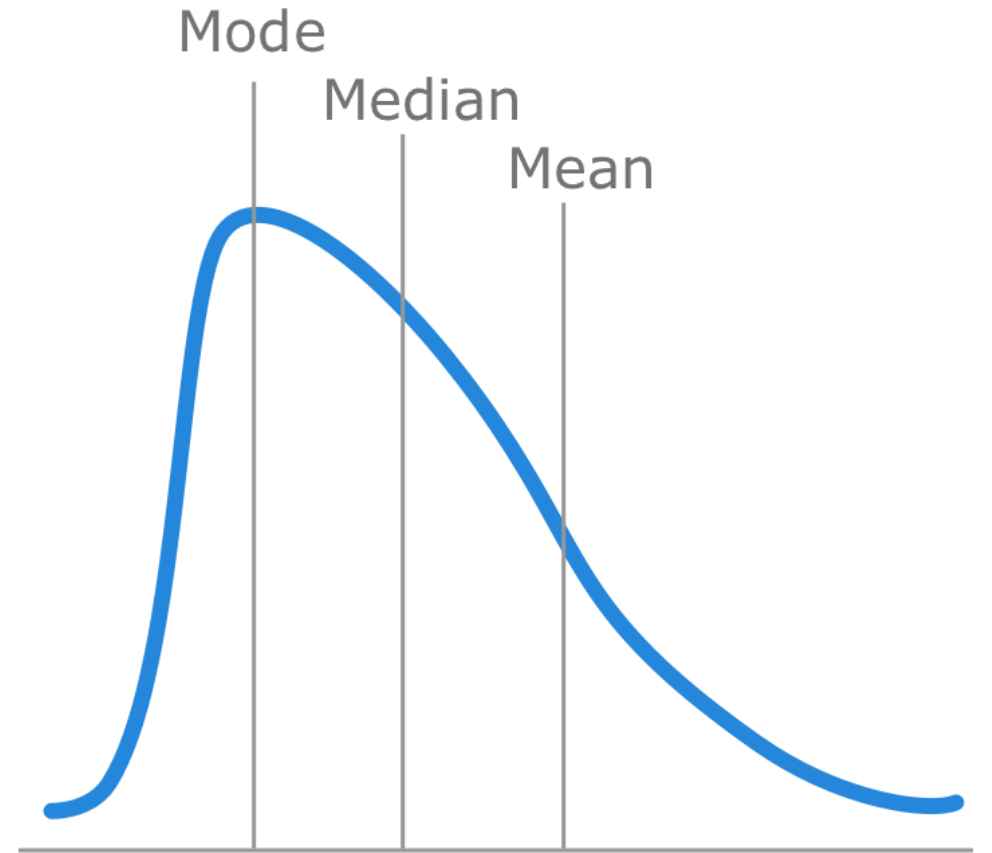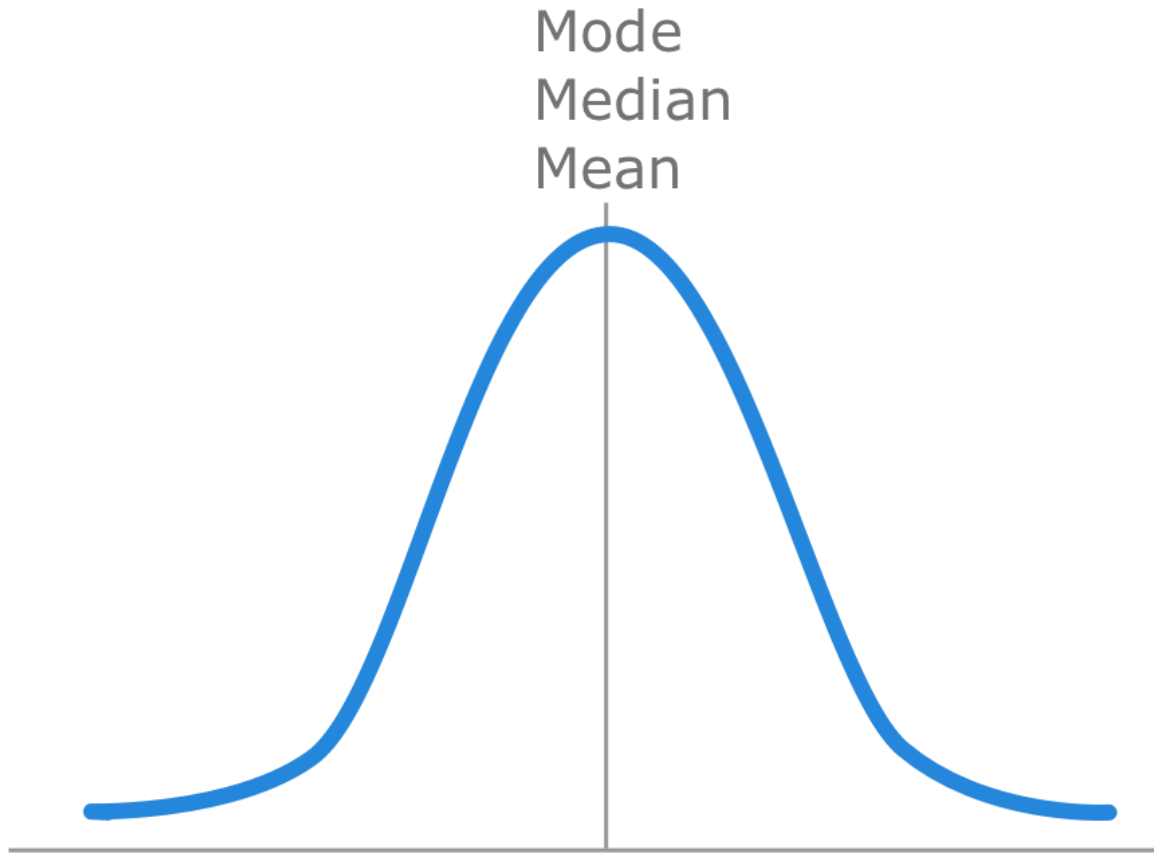# Why do we visualize data?

Jock Mackinlay

Expressiveness

tell the **truth** and nothing but the truth.

(don't lie, not even by **omission**)

Effectiveness

use code that **humans** are **best** at **decoding**.

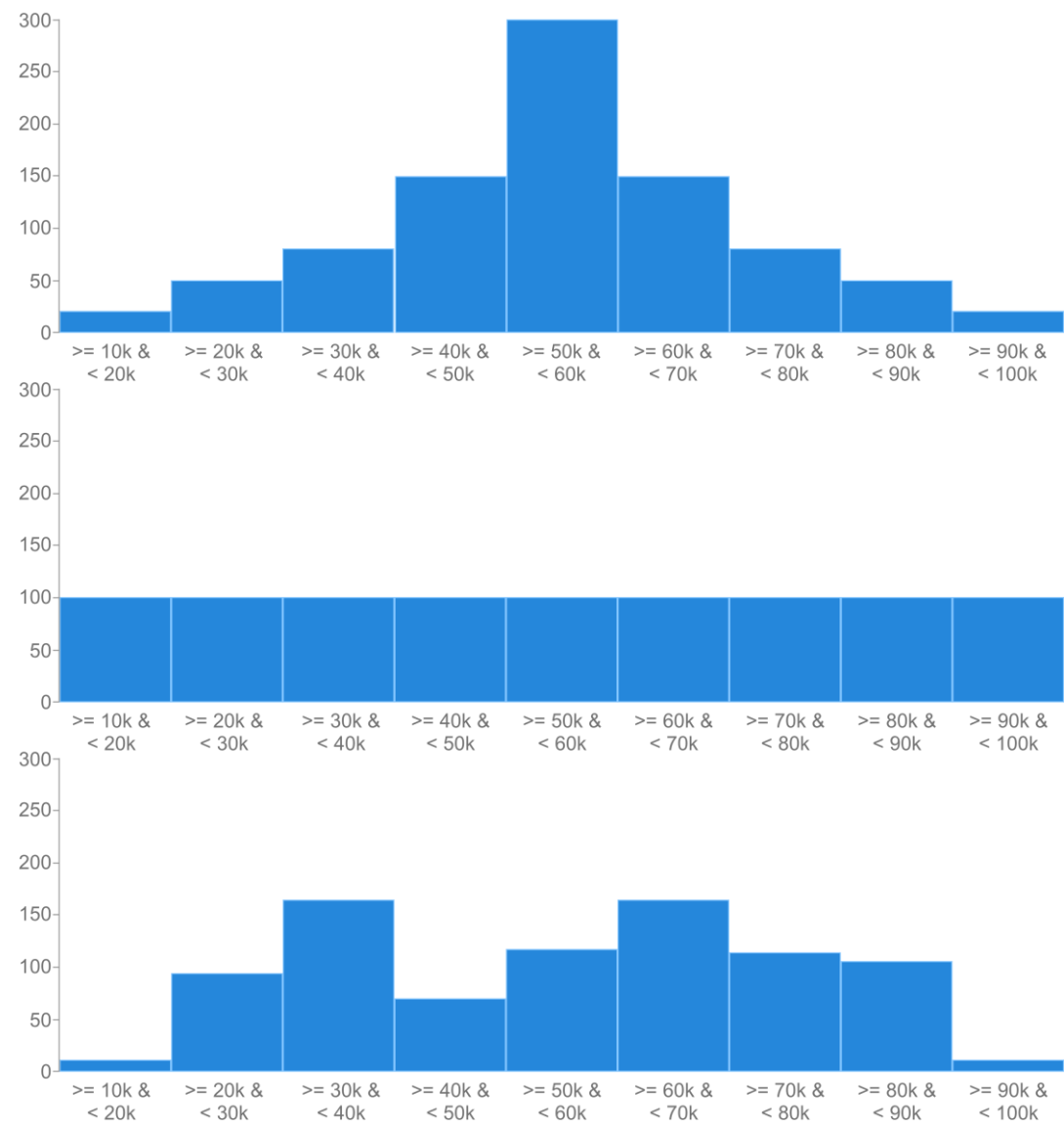(best = faster and/or more accurate)

Quantitative thinking

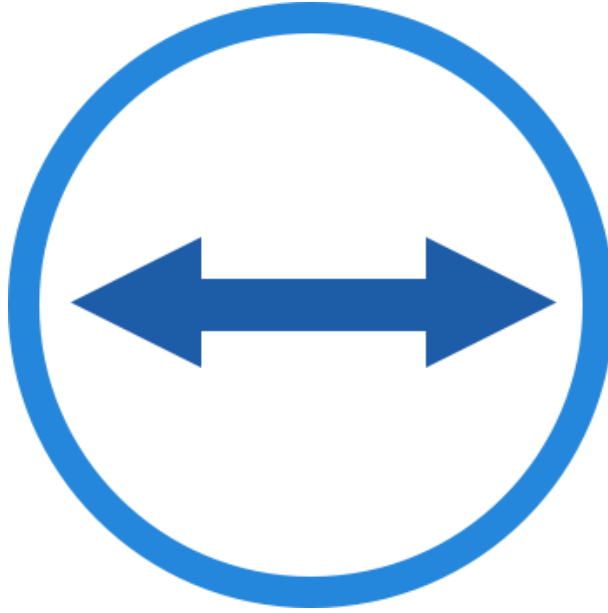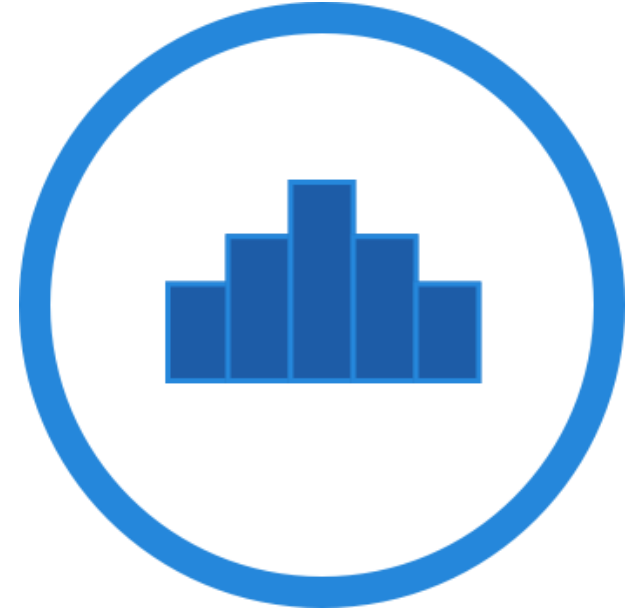# Quantitative thinking

Mean income

55k

Quantitative thinking
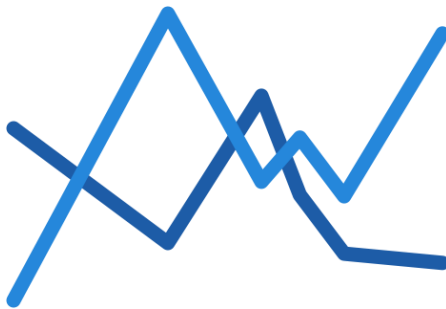

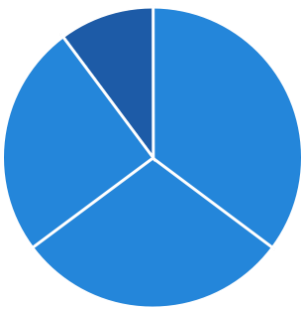**Central Tendency**

Spread

Shape

Quantitative thinking

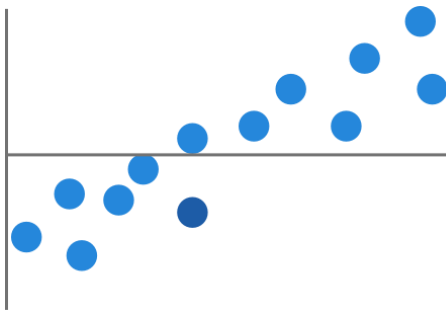nominal comparison

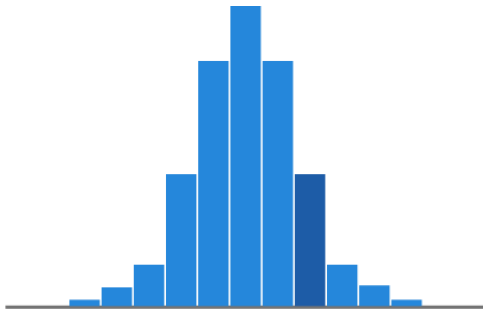time series

ranking

part-to-whole

deviation

Source: Show me the numbers, Stephen Few

correlation

distribution

geospatial

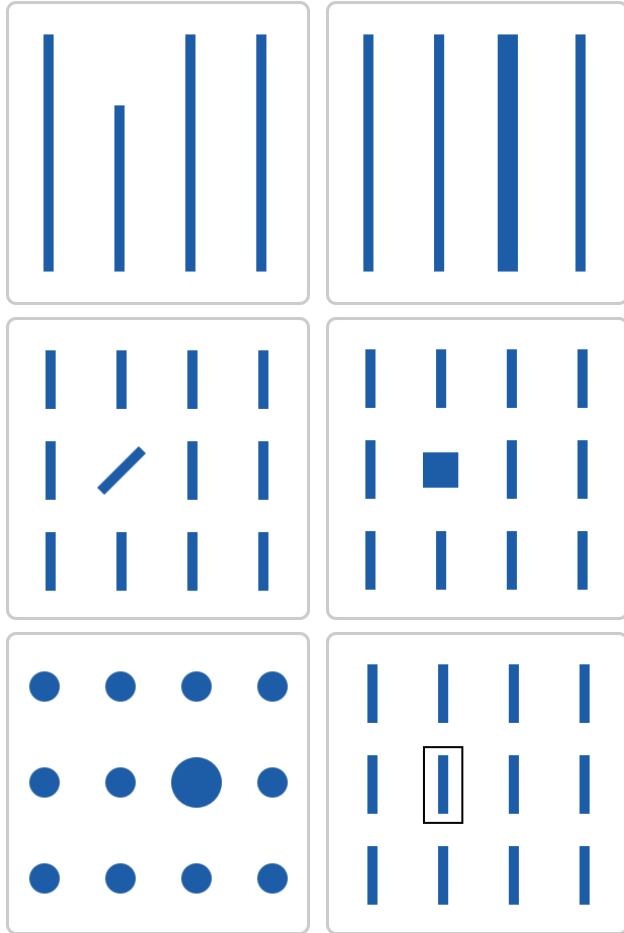# Training Agenda

Human Perception

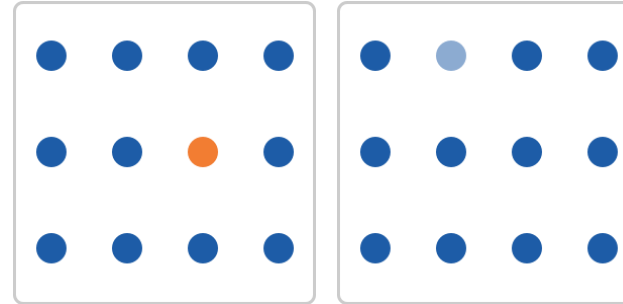**We see with our brains**

Pre-attentive attributes

Gestalt
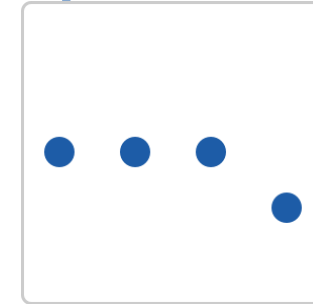
System 1 & System 2

Pre-attentive attributes

Form

Color

Spatial Position

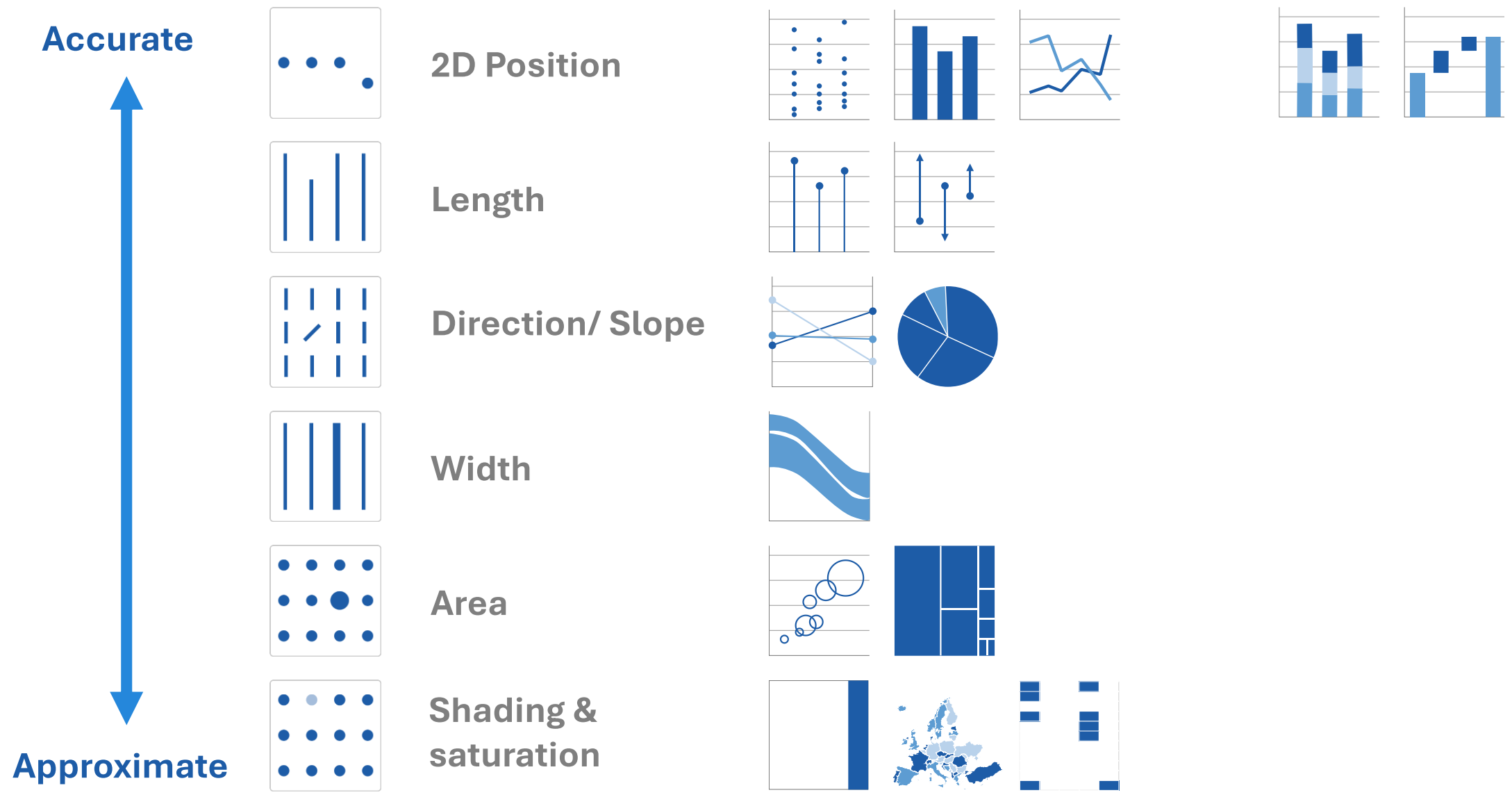# Human perception

 Sensory Memory – Iconic Memory

 Short-term Memory – Working Memory

 Long-term Memory

Scale of elementary perceptual tasks

Thinking, Fast and Slow

System 1

Fast

Unconscious

Automated

Everyday decisions

Error prone

System 2

Slow

Conscious

Effortful

Complex decisions

Reliable

Table or Chart?

	Jan	Feb	Mar	Apr	May	Jun
product 1	267	357	587	320	268	398
product 2	365	387	401	406	421	404
product 3	554	582	561	551	583	600
Total	**1.186**	**1.326**	**1.549**	**1.277**	**1.272**	**1.402**

Lifespan (years) / Income (GDP per capita in USD x 1,000) / Population (millions): <=10, >10 & <= 100, > 1.000

- **Lookup/Compare** individual values

- **Precision** is required

- **Multiple** units of **measure**

- Summary & detail values **combined**
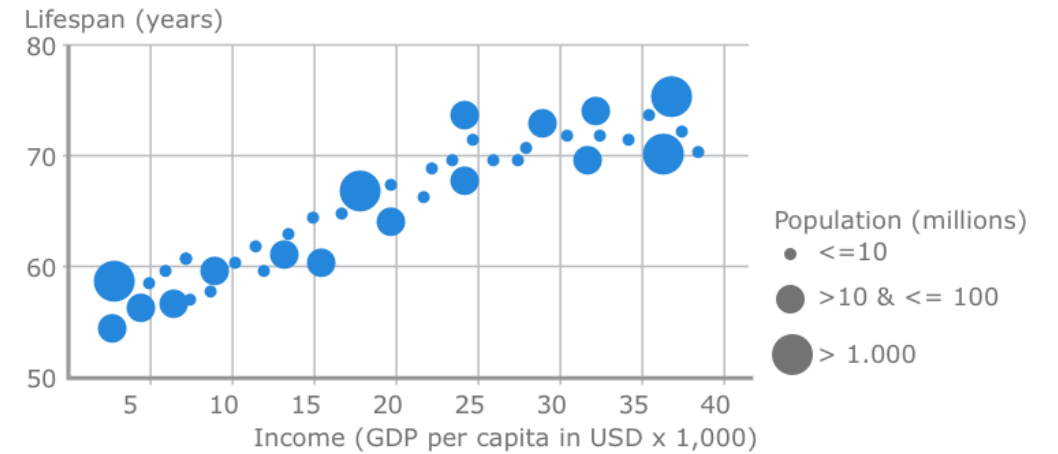
- Message contained in the **shape of the values**

- Reveal **relationships** among whole **sets of values**

CHRTTS

Categorical
Comparing categories and distributions of quantitative values

Hierarchical
Revealing part-to-whole relationships and hierarchies

Relational
Exploring correlations and connections

Temporal
Plotting trends and intervals over time

Tabular
Organizing observations by variable to allow precise comparison

Spatial
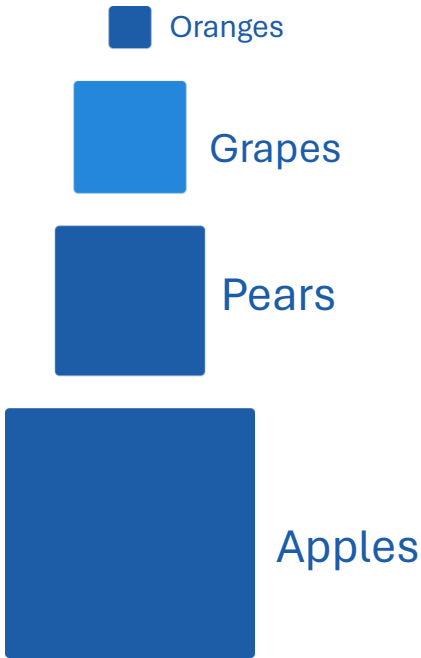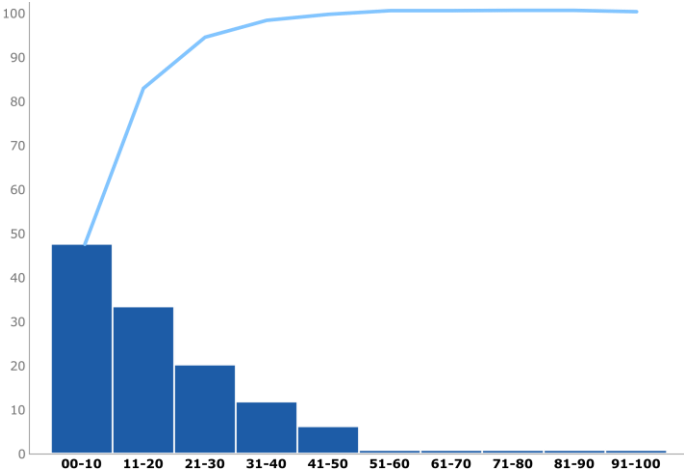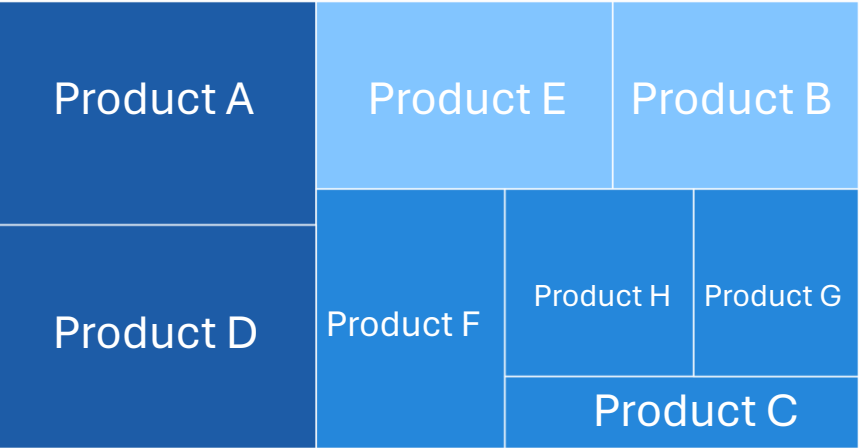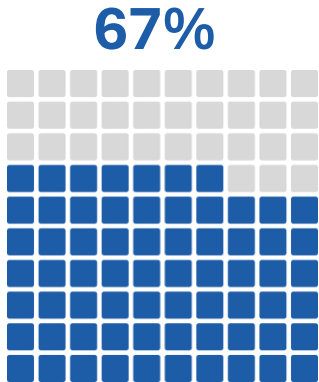Mapping spatial patterns through overlays and distortions

CHRTTS

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Spatial
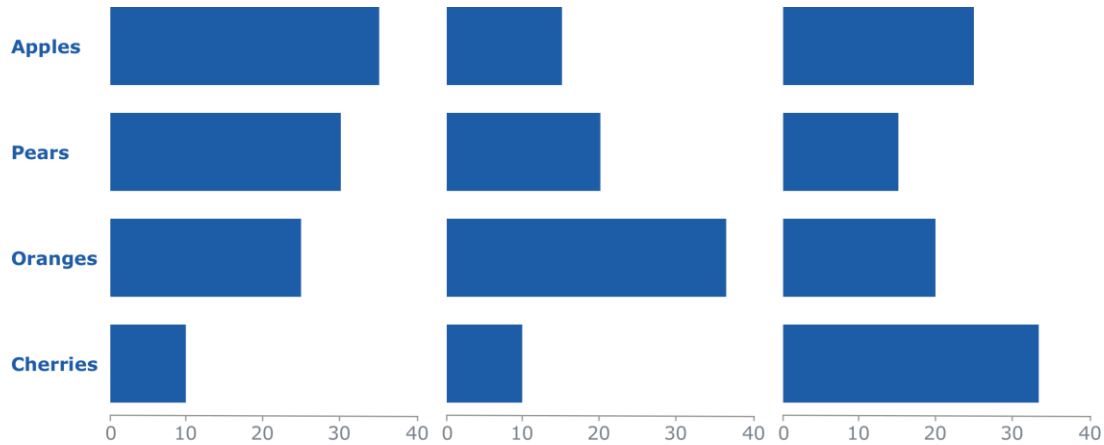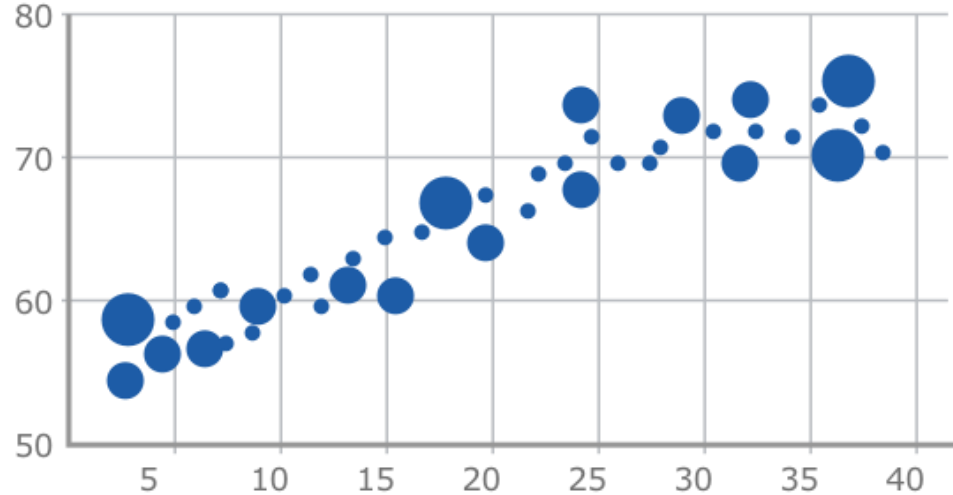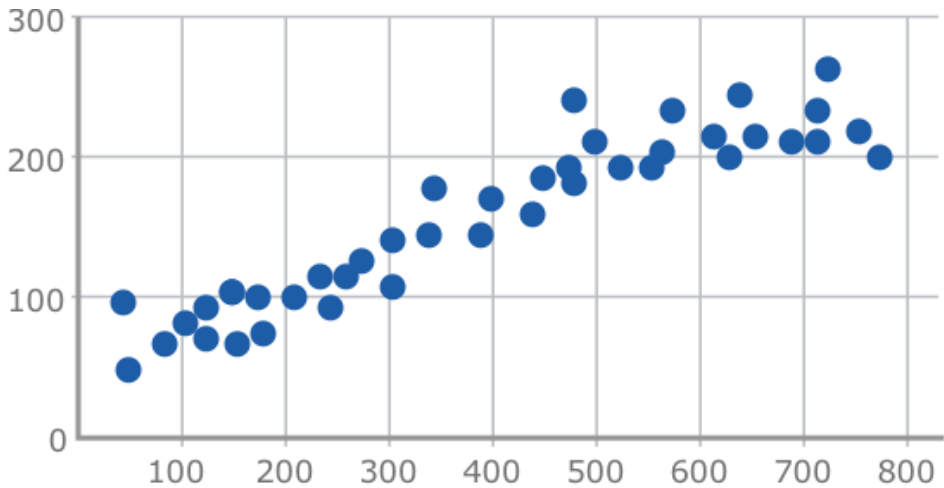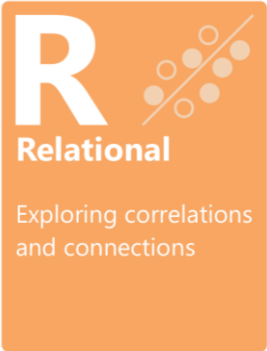Mapping spatial patterns through overlays and distortions

Hierarchical

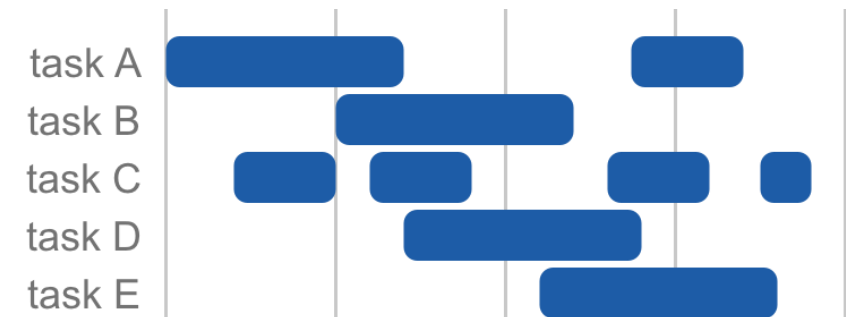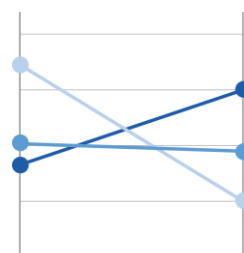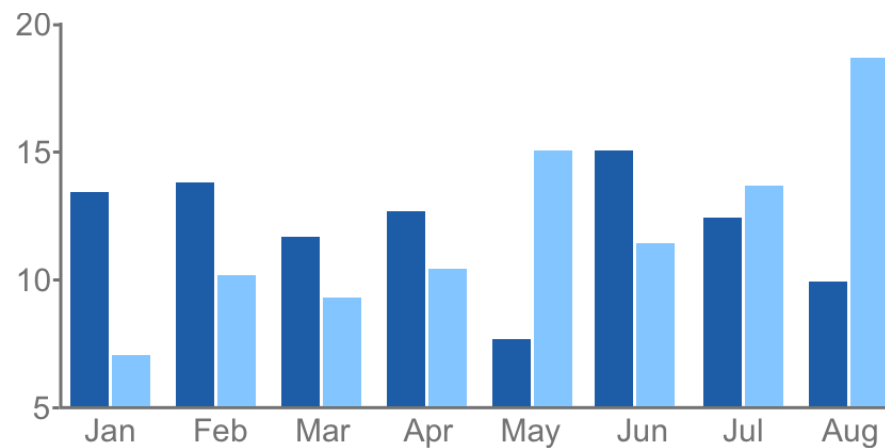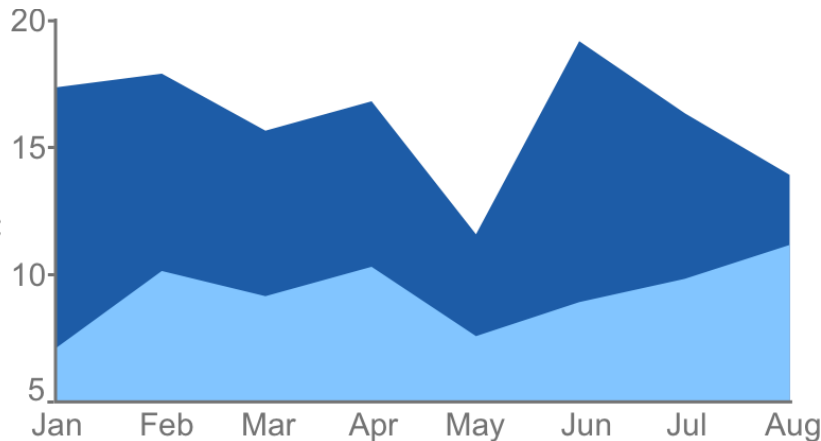Revealing part-to-whole relationships and hierarchies

Hierarchical

Relational
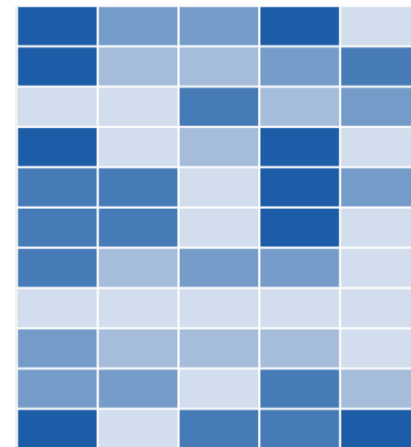
Relational

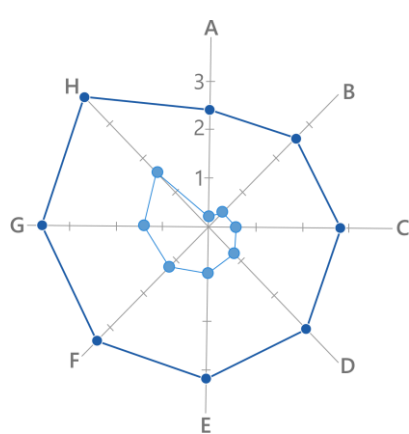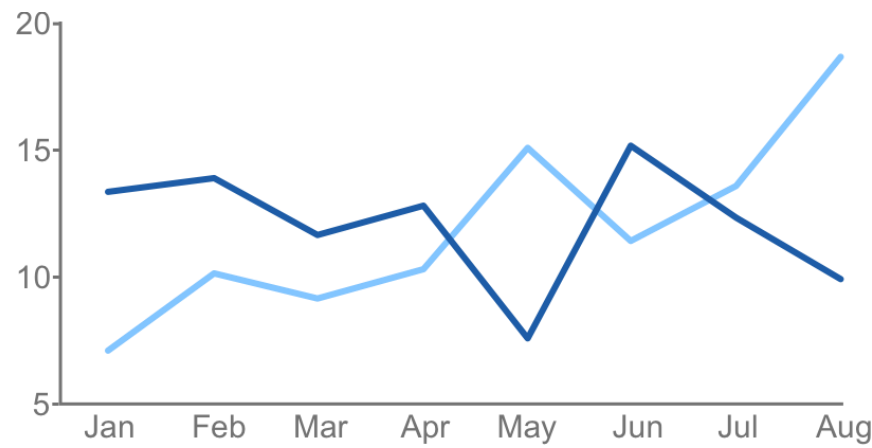Exploring correlations and connections

Temporal

Plotting trends and intervals over time

Temporal

Tabular

Tabular

Organizing observations by variable to allow precise comparison

		Jan	Feb	Mar	Apr	May	Jun
market A	product 1	267	357	587	320	268	398
	product 2	365	387	401	406	421	404
	product 3	554	582	561	551	583	600
market B	product 4	267	357	587	320	268	398
	product 5	365	387	401	406	421	404
	product 6	554	582	561	551	583	600

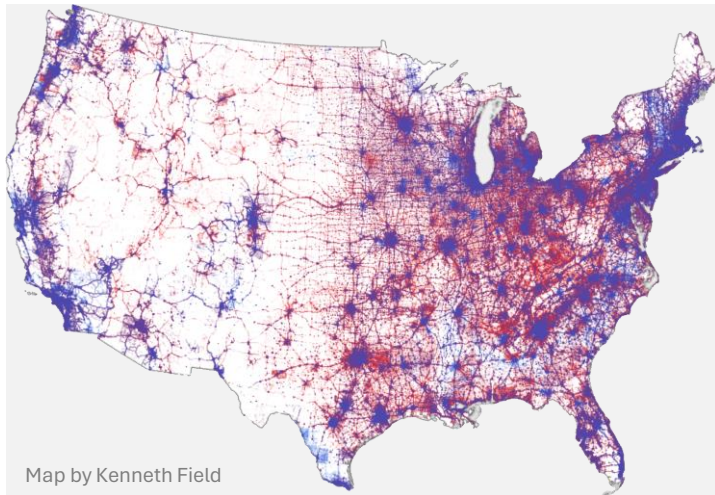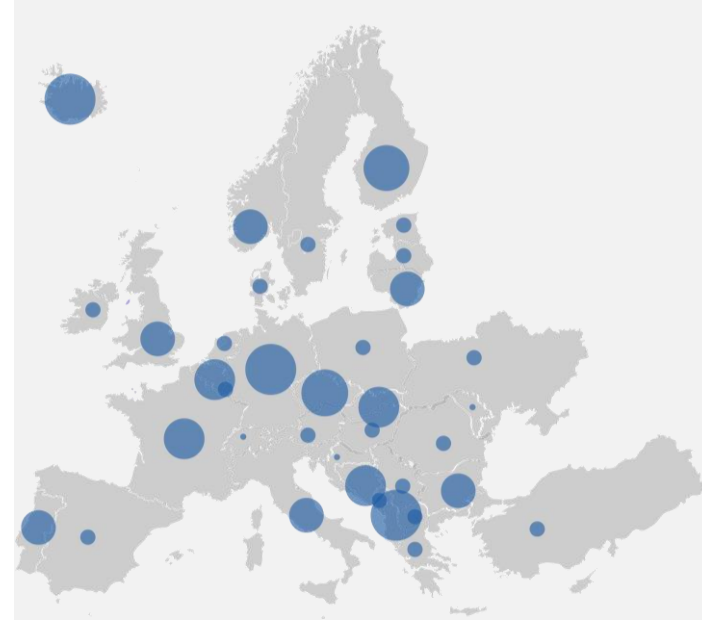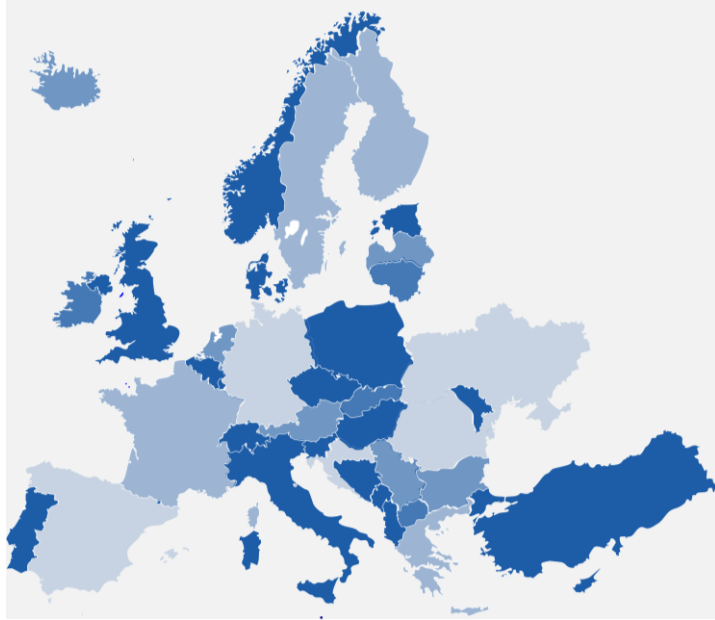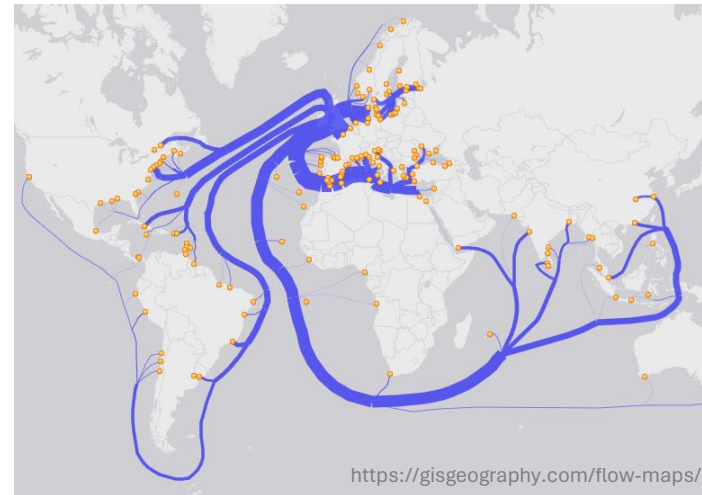| Market	Product	Month	Measure
market A	product 1	Jan	267
market A	product 2	Jan	365
market A	product 3	Jan	554
market B	product 1	Jan	267
market B	product 2	Jan	365
market B	product 3	Jan	554
…	…	…	…

Spatial

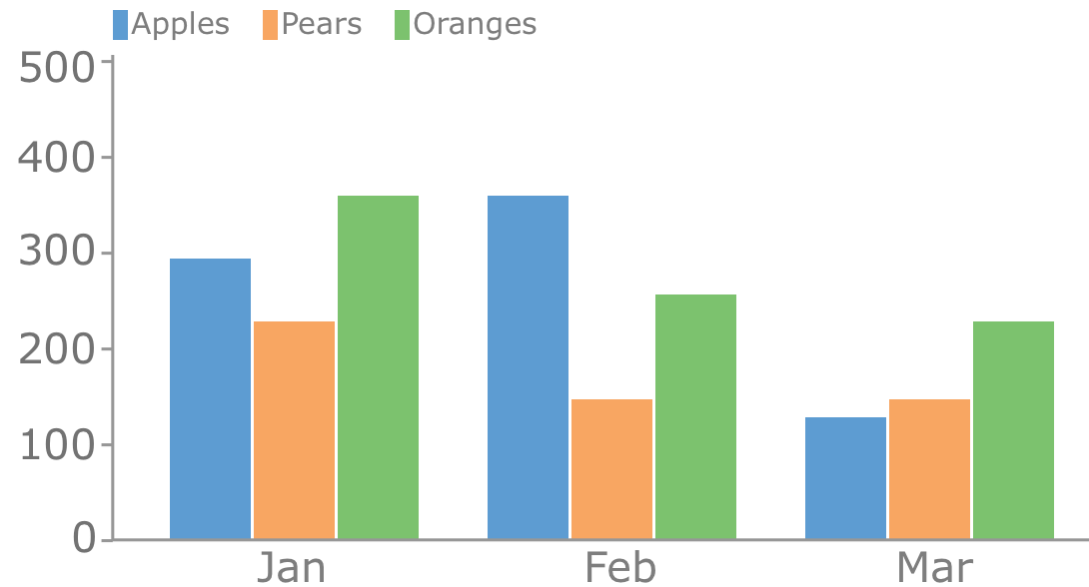Mapping spatial patterns through overlays and distortions
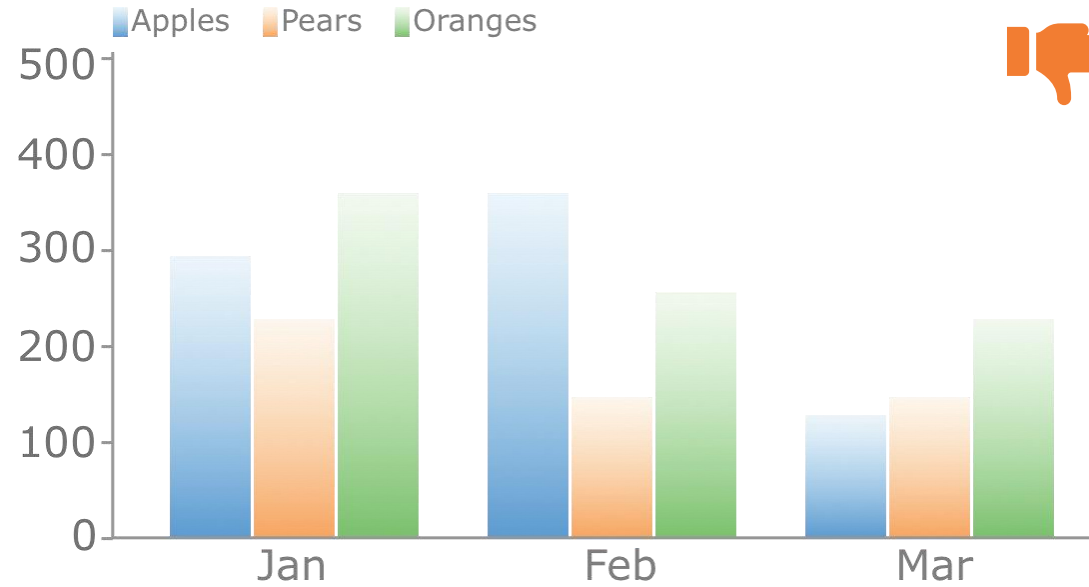
S Spatial

Map by Kenneth Field

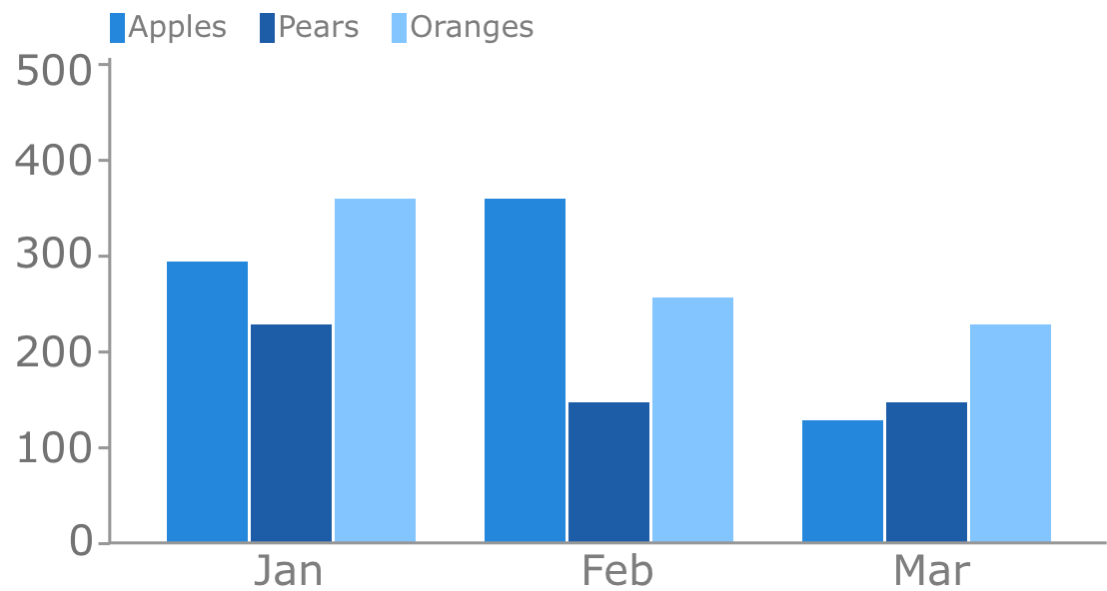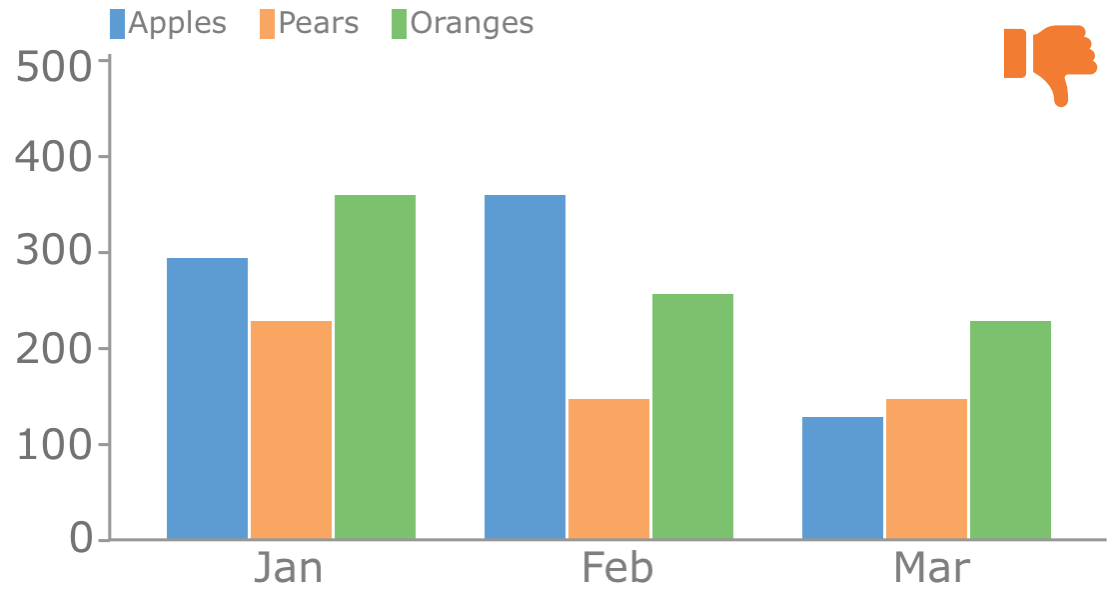https://gisgeography.com/flow-maps/

Color: Avoid the use of gradients

Color: Limit the number of colors

Info-seeking mantra

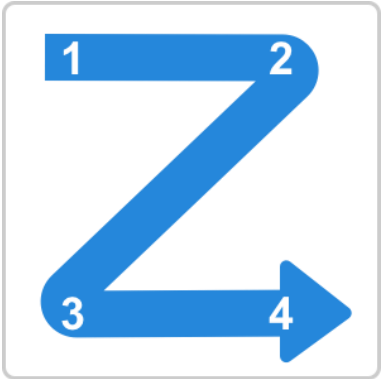**Overview** first,

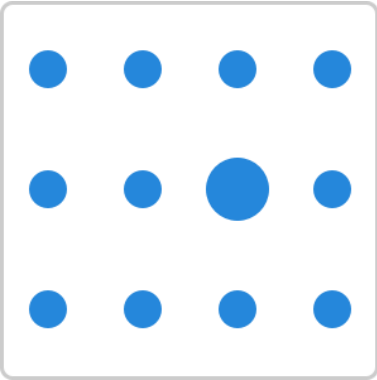**zoom** & **filter**,

details on demand.

Management Dashboard

A dashboard is a **visual display**
of the most important information needed to
achieve one or more objectives
that has been
consolidated on a **single computer screen**
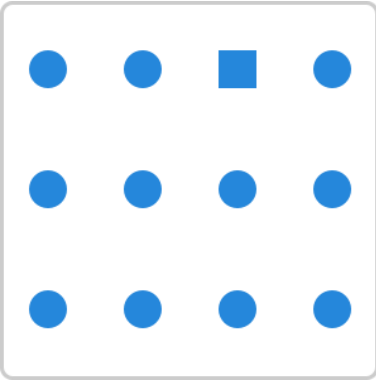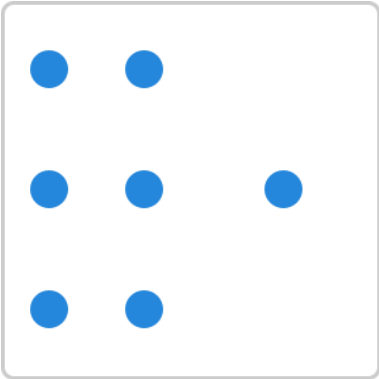so it can be
monitored at a glance

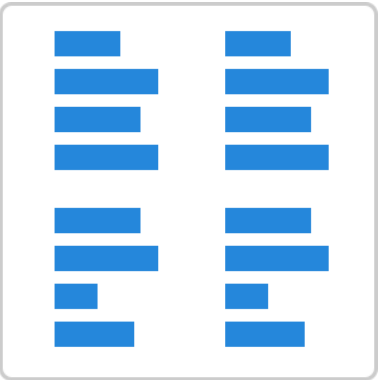# Visual hierarchy

Composition

Size

Shape

Padding

Alignment

Contrast
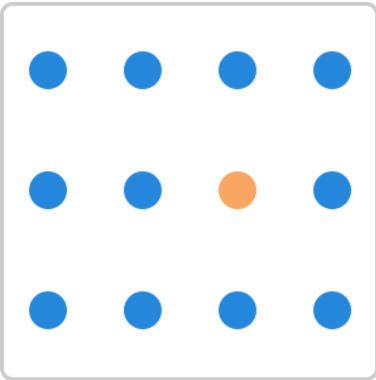
Hue
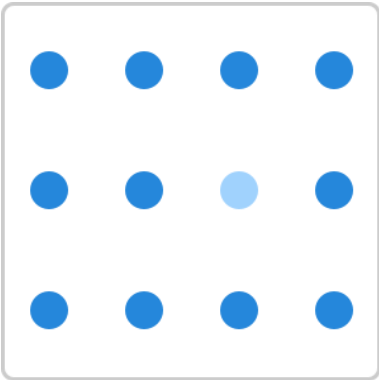
Saturation

Explore to Explain
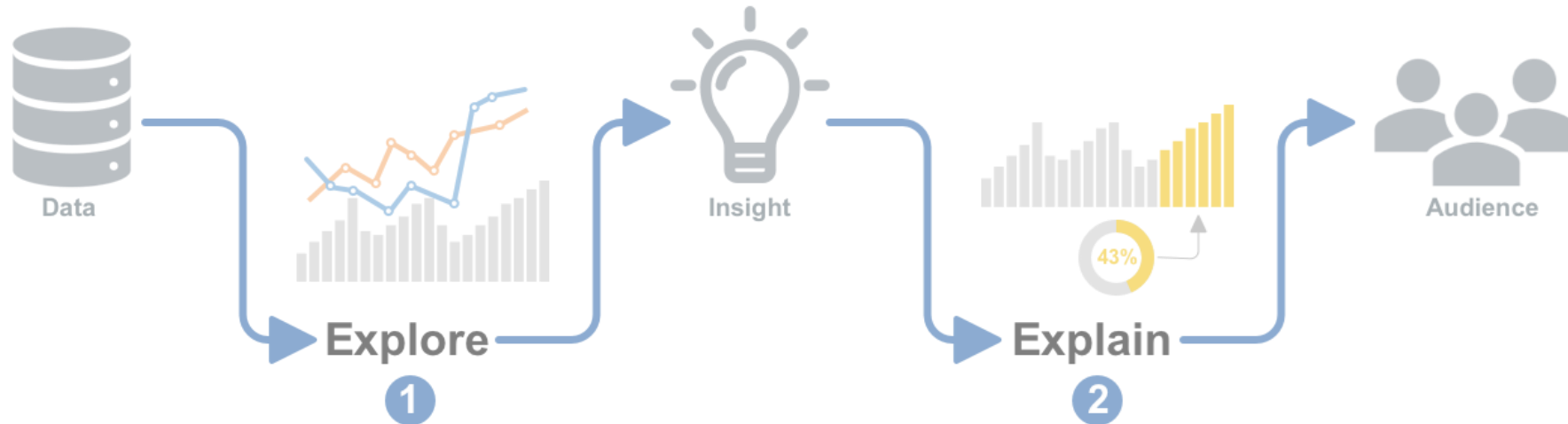
	Explore ①	**Explain** ②
🎯	**Understand**	**Communicate**
👥	**You**	**Other people**
🚀	**Very familiar**	**Less familiar**
👁	**Flexibility & speed**	**Simplicity, clarity & cohesion**
💬	**Unknown**	**Known**
🏆	**Insight**	**Action**

Storytelling Arc

3 Aha Moment
Major finding or central insight

2 Rising Insights
Supporting details that reveal deeper insight into the problem or opportunity

4 Solution & Next Steps
Potential options and recommendation

1 Setting
Background on current situation, character(s), and the Hook

Audience's knowledge is enriched and likelihood to act is increased

What?   **Why?**   **What's next?**

Effective approach

works

BOLD Beauty

function

ugly ← form → pretty

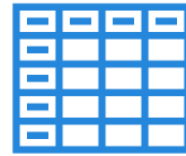JUNK *Kitsch*

broken

Style Guide

Colors

Charts

Fonts

Tables

Numeric formats

Choosing the best

Theory, explain

Examples