

# Data Visualization & Design

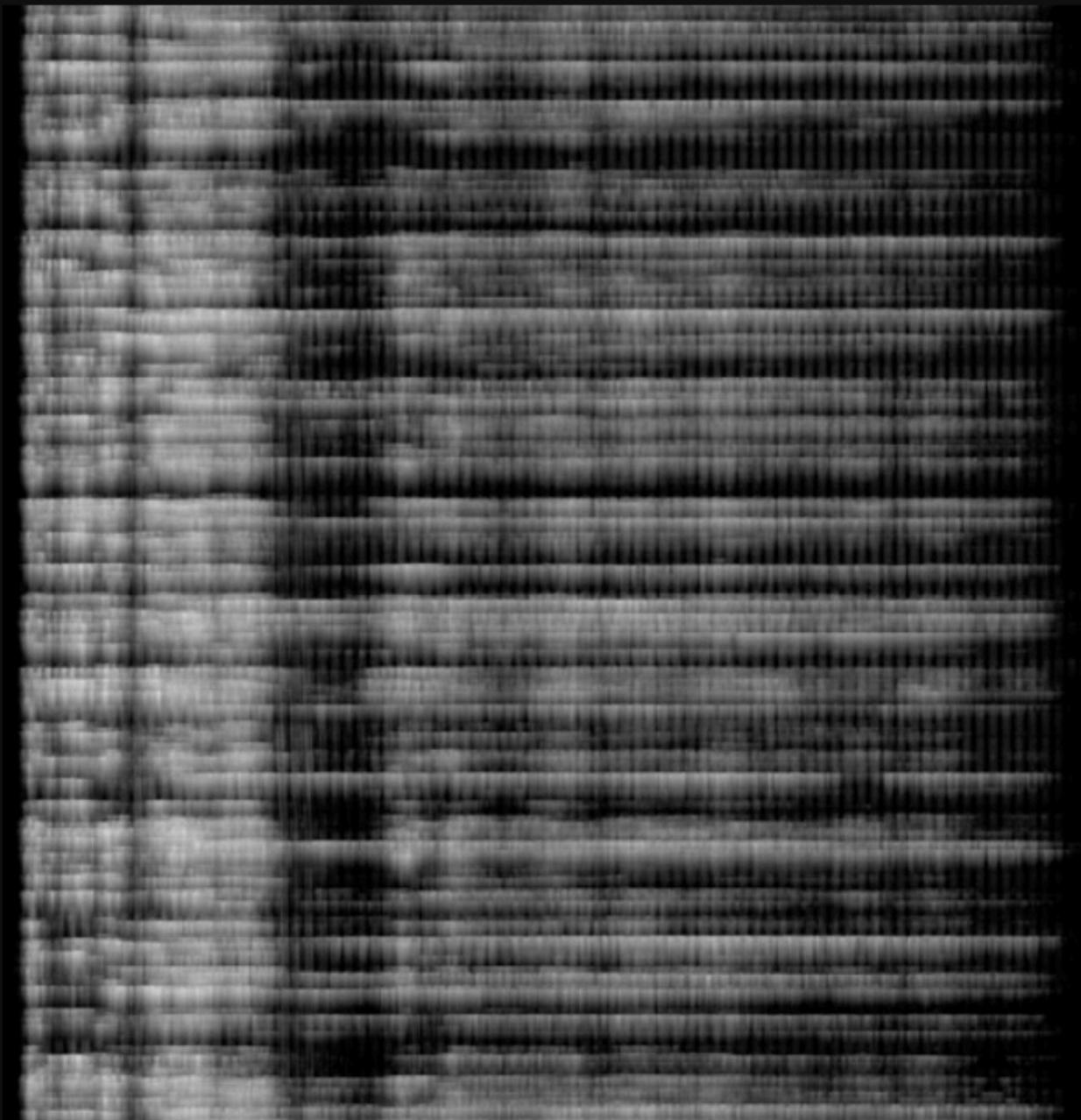
**Week 5**

This week in **visualization** –

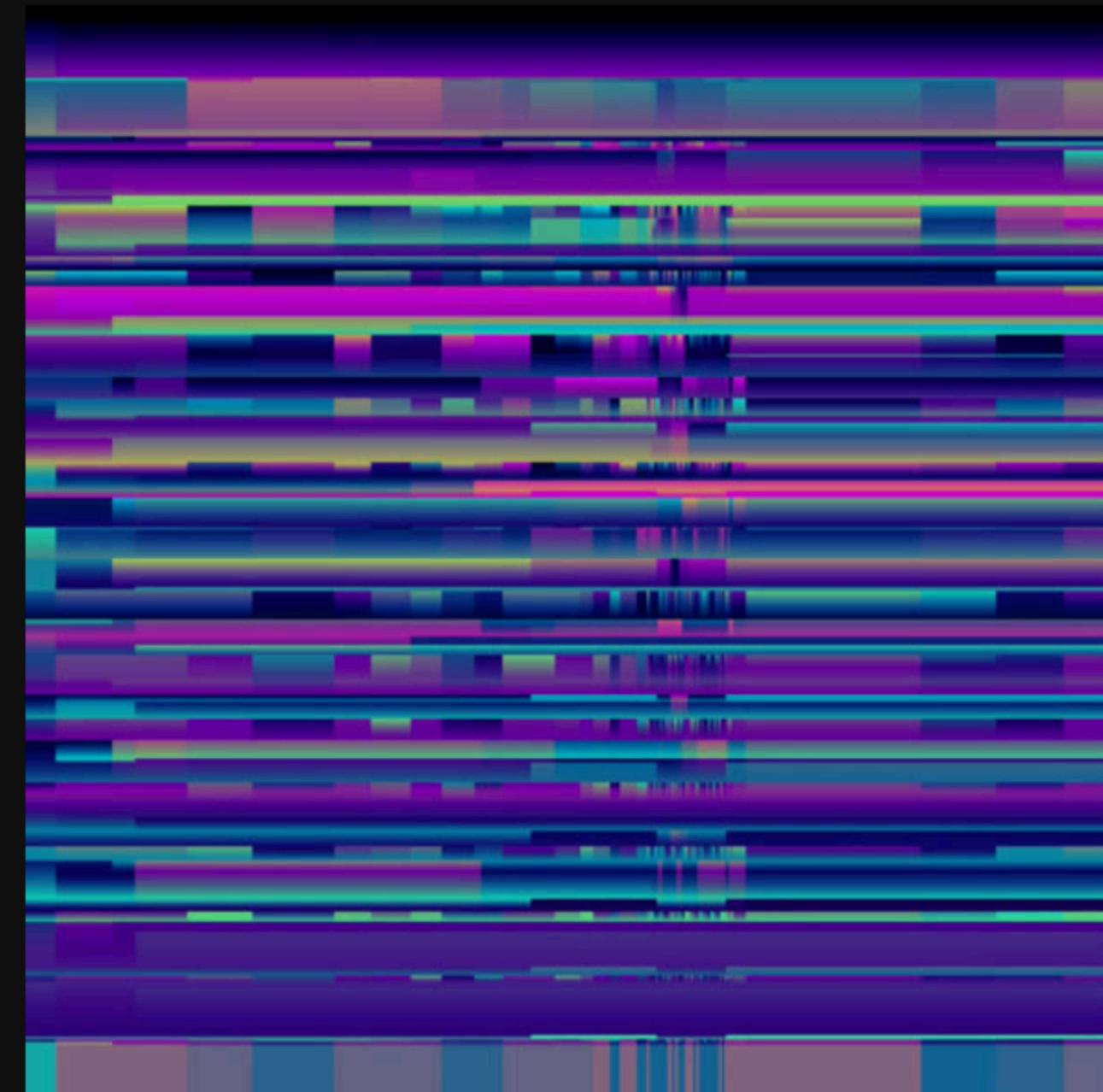
# AI SENSES

AI Senses visualizes sensor data of the machines that surround us to develop an understanding how they experience the world.

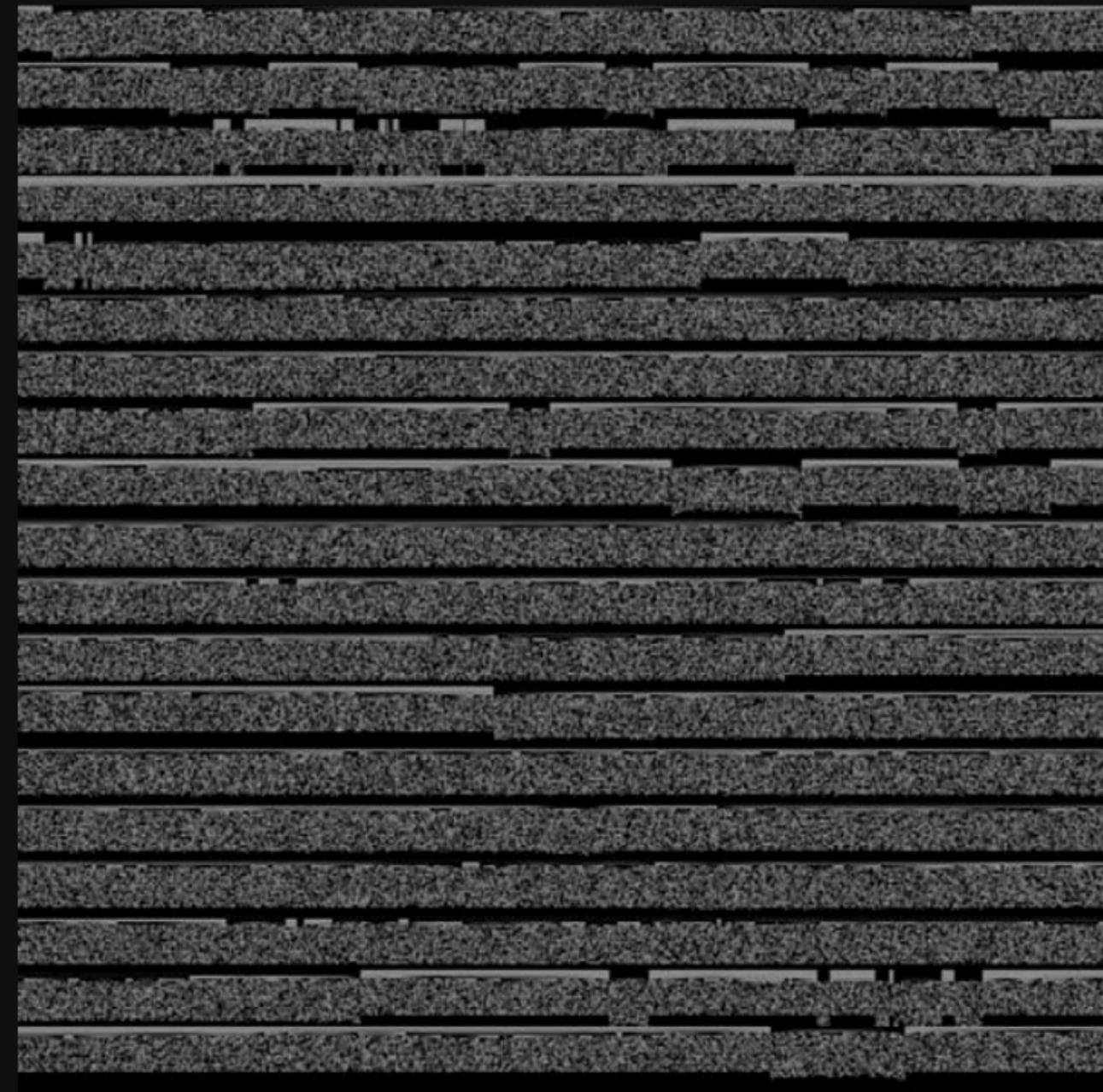
In current times, machine learning and artificial intelligence are buzzwords. But they are more than that—they influence our behavior as well as our conception of the technologies themselves and the world they represent. A lack of understanding of how these systems operate on their own terms is dangerous. How can we live with, trust, and interact with this alien species, which we set forth into the world, if we know it only through interfaces designed to make the machine unnaturally akin to the world we already know? This project visualizes raw sensor data that our phones and computers collect and process, to help us understand how these machines experience the world.



HEARING



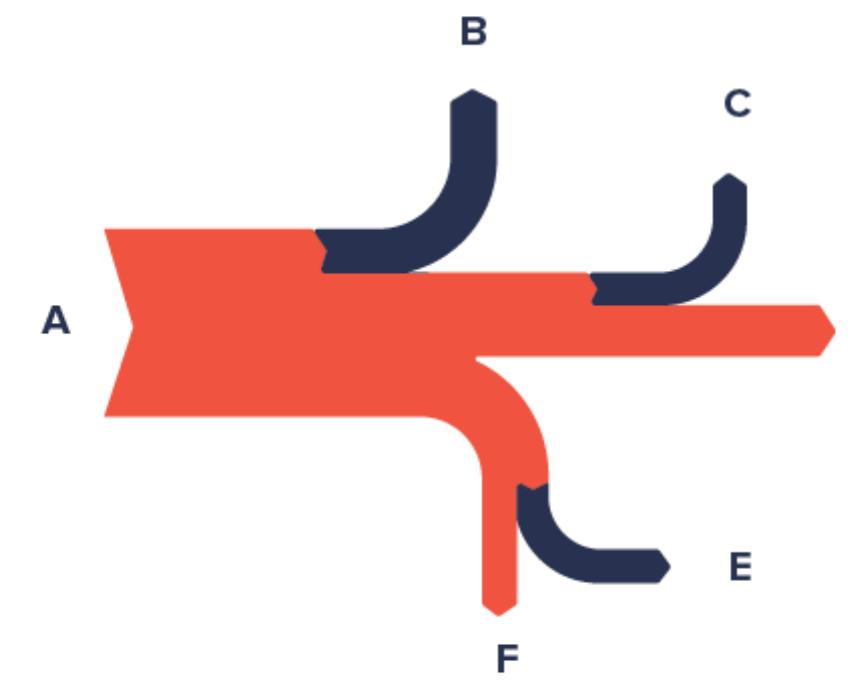
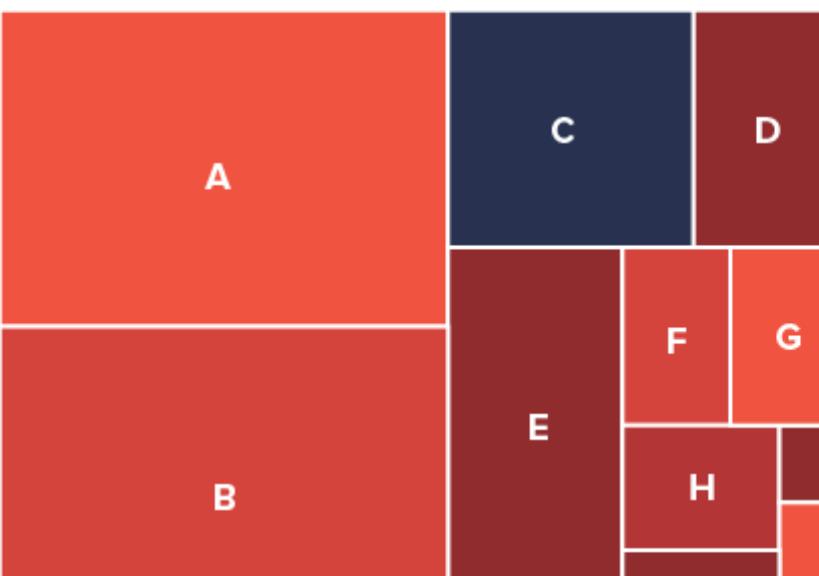
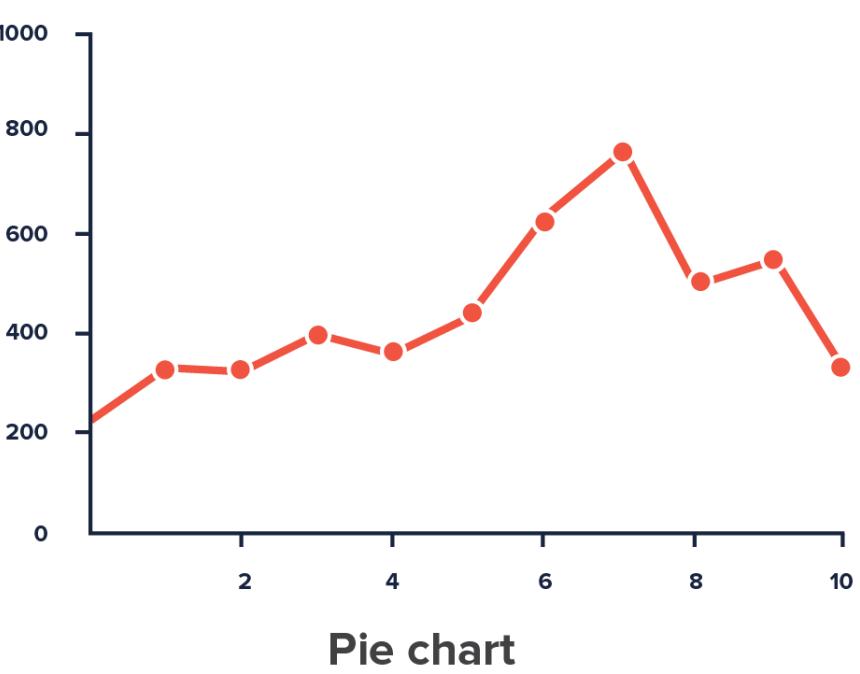
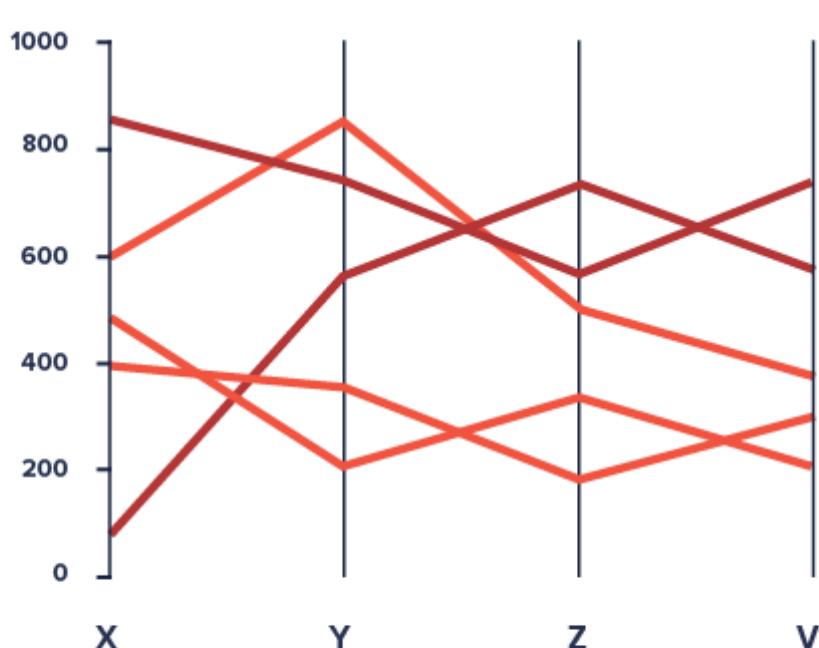
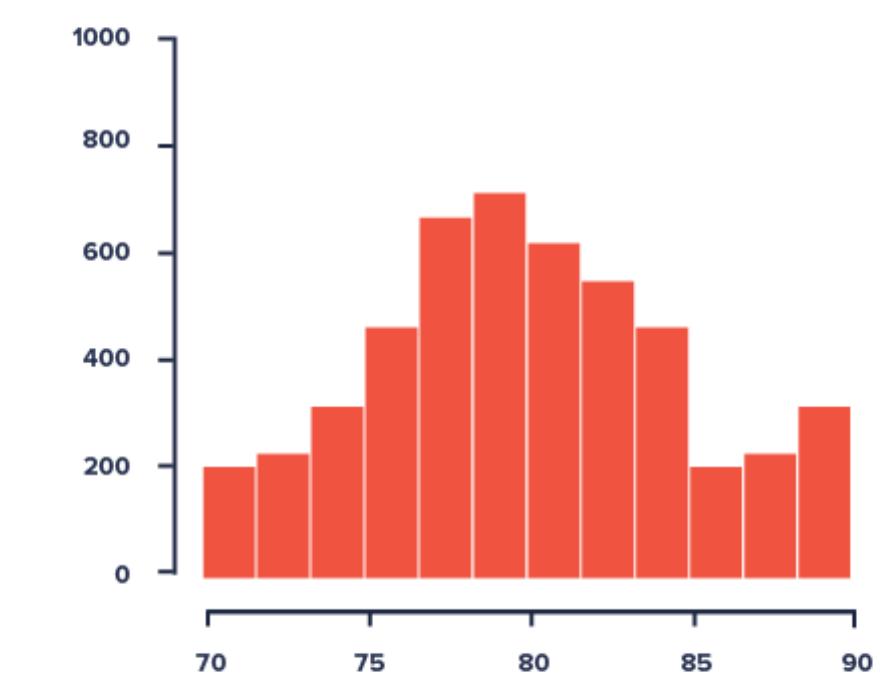
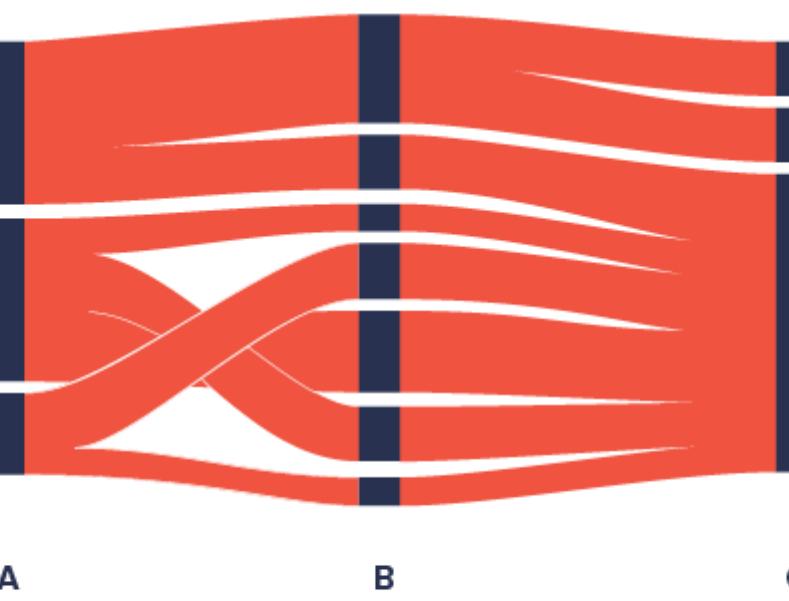
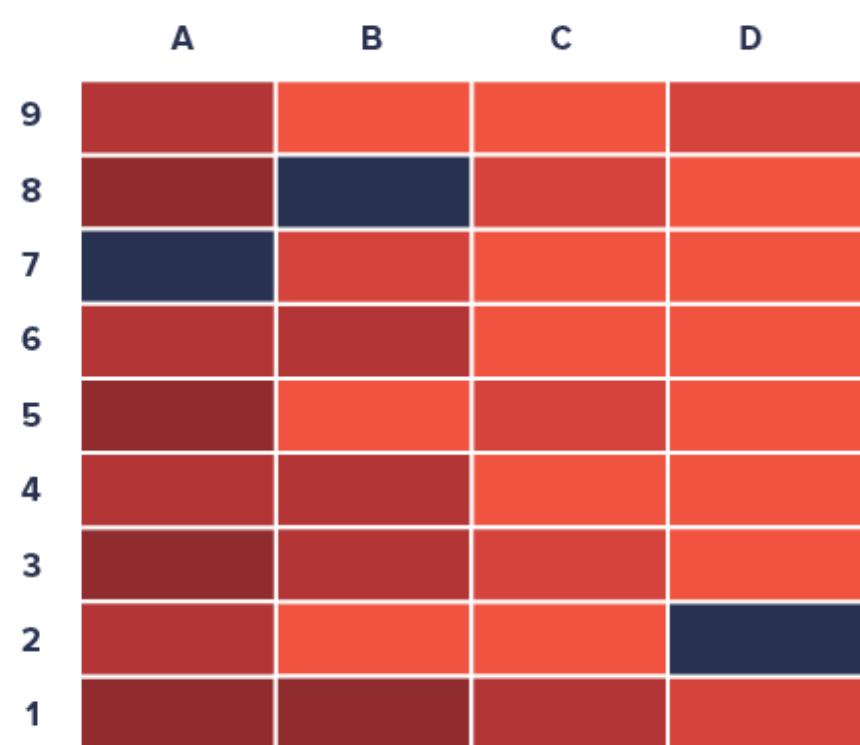
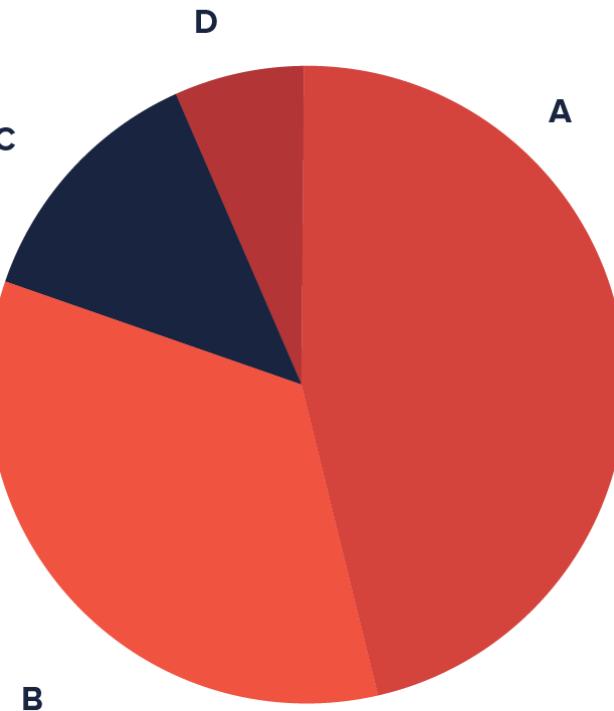
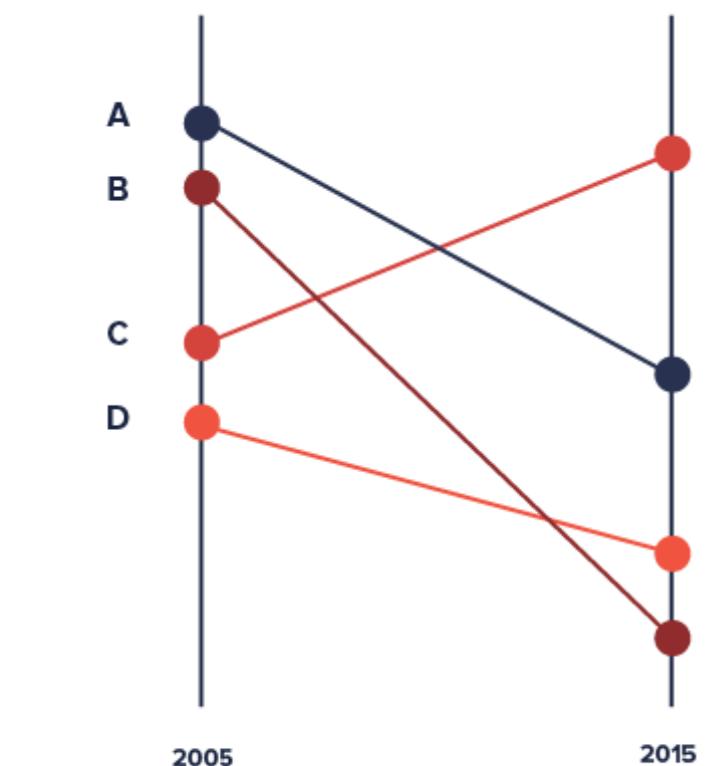
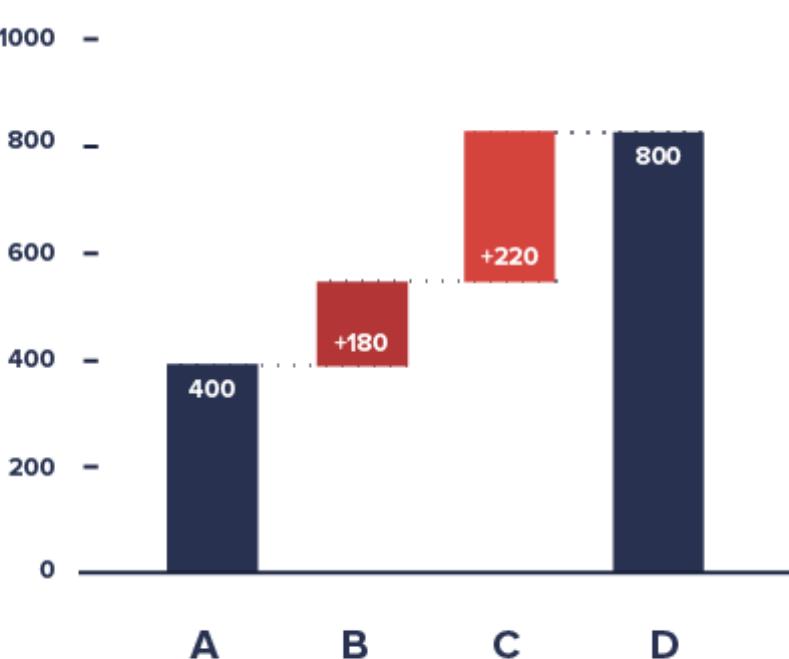
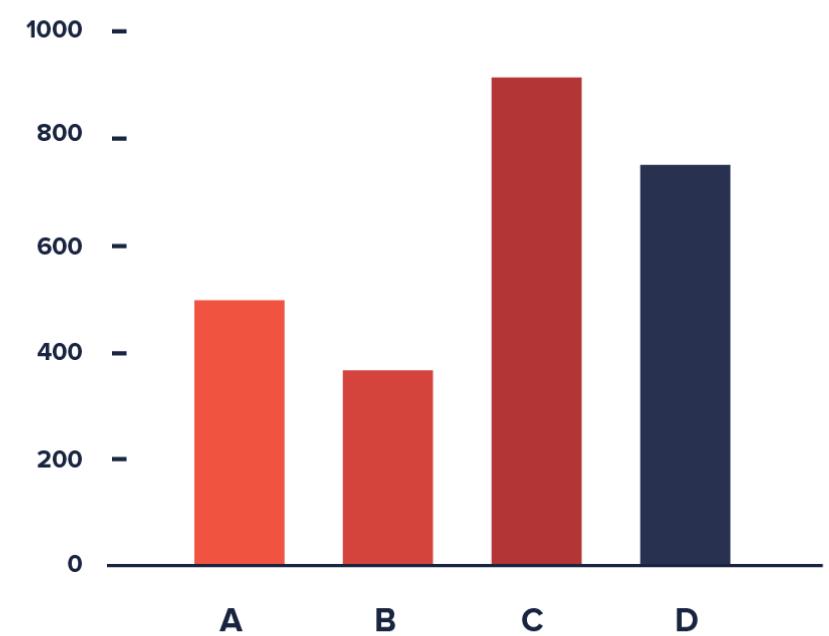
TOUCHING LIVE



ORIENTING

[Source](#)

# Charts & diagrams



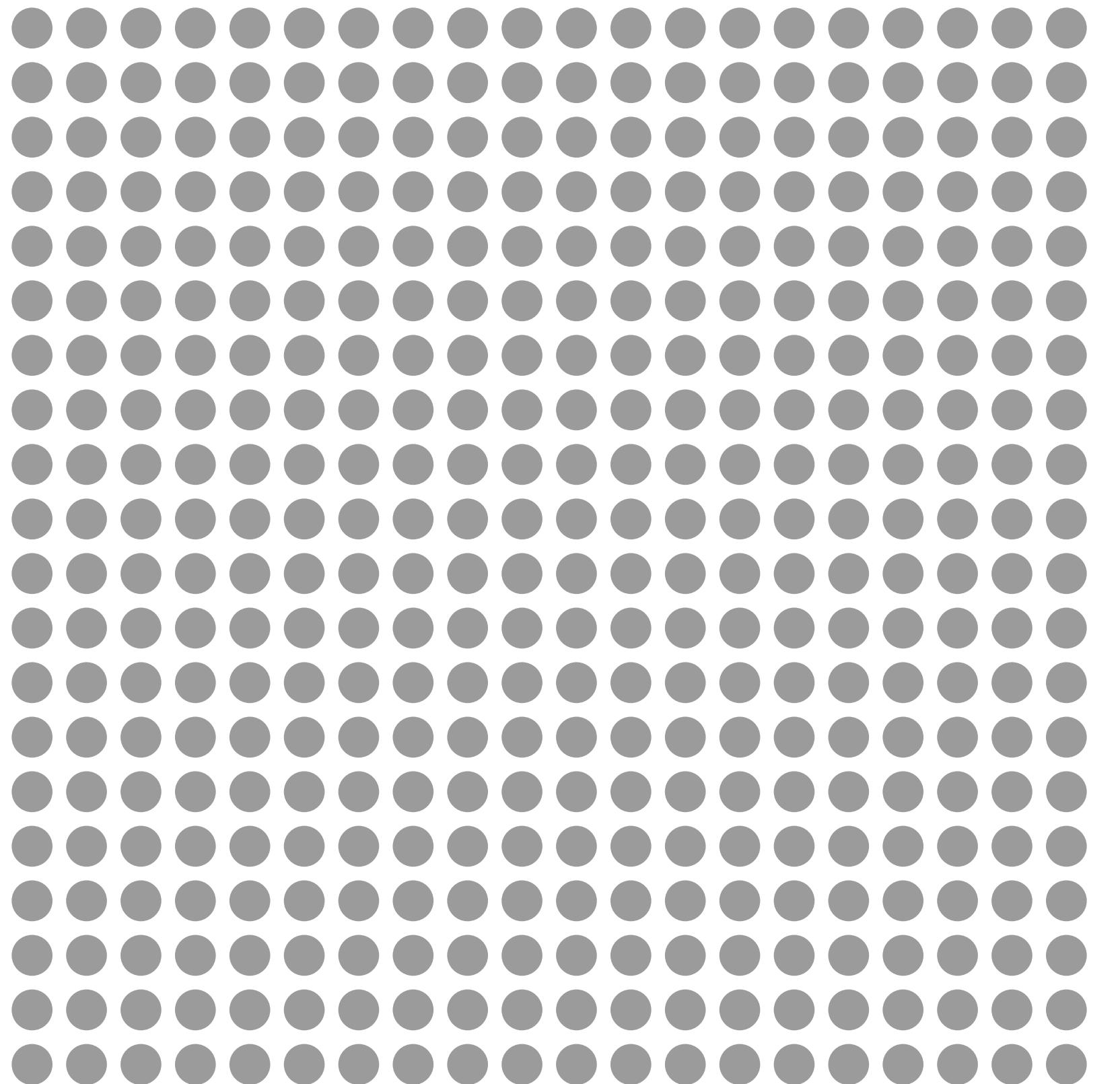
# Approaches to **chart & diagram** classification

- Grouping
- Temporality
- Functions

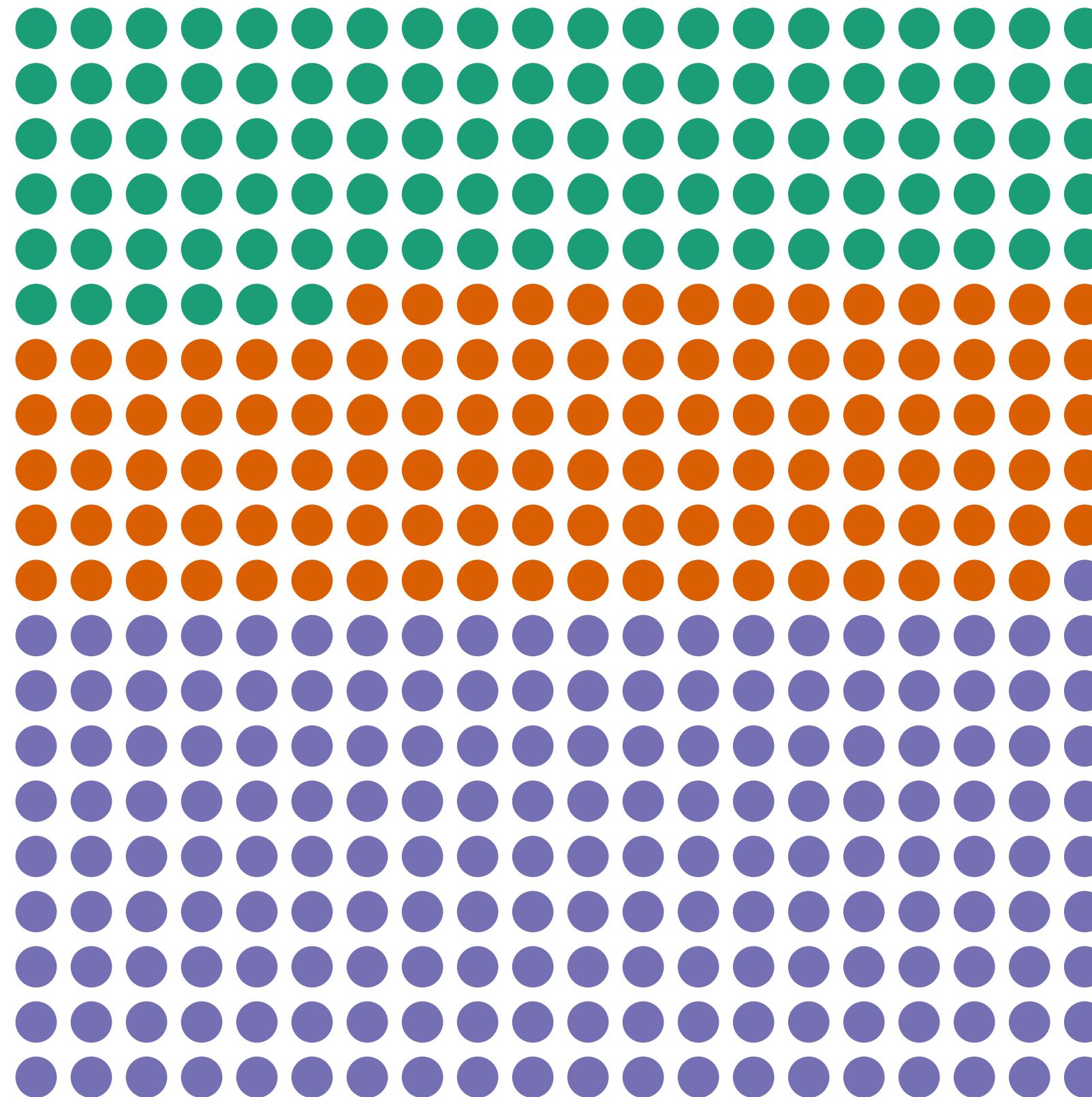
# Approaches to **chart & diagram** classification

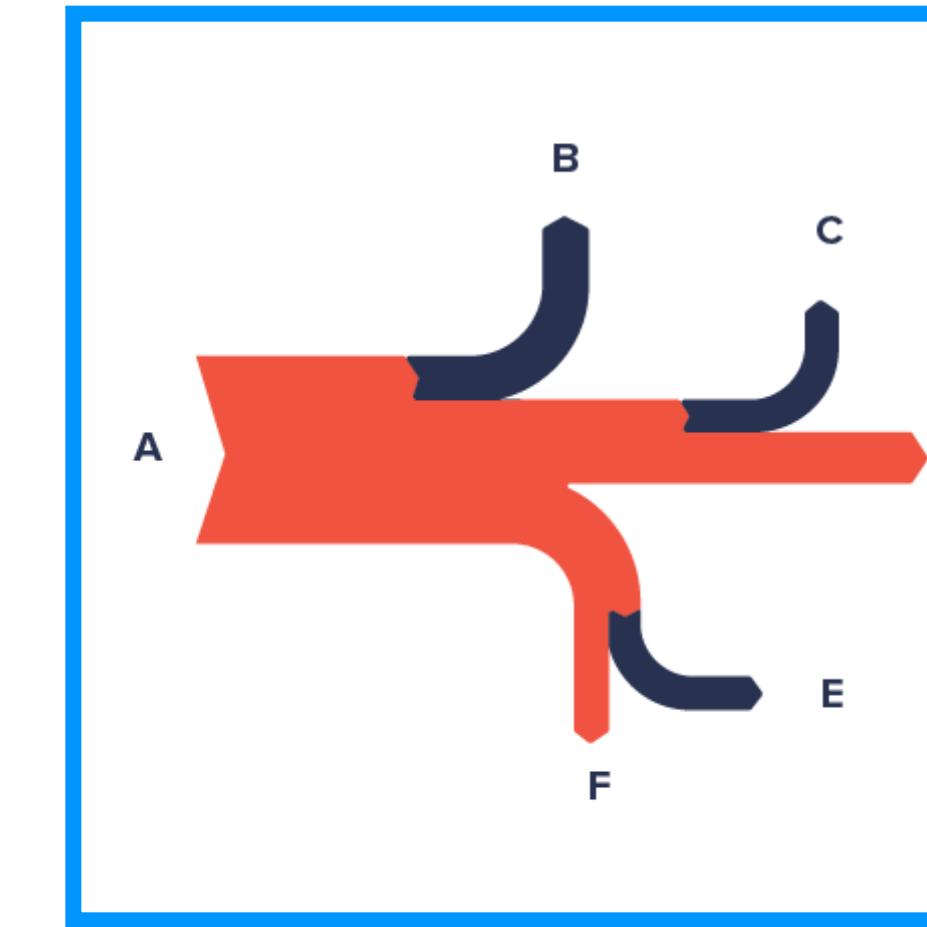
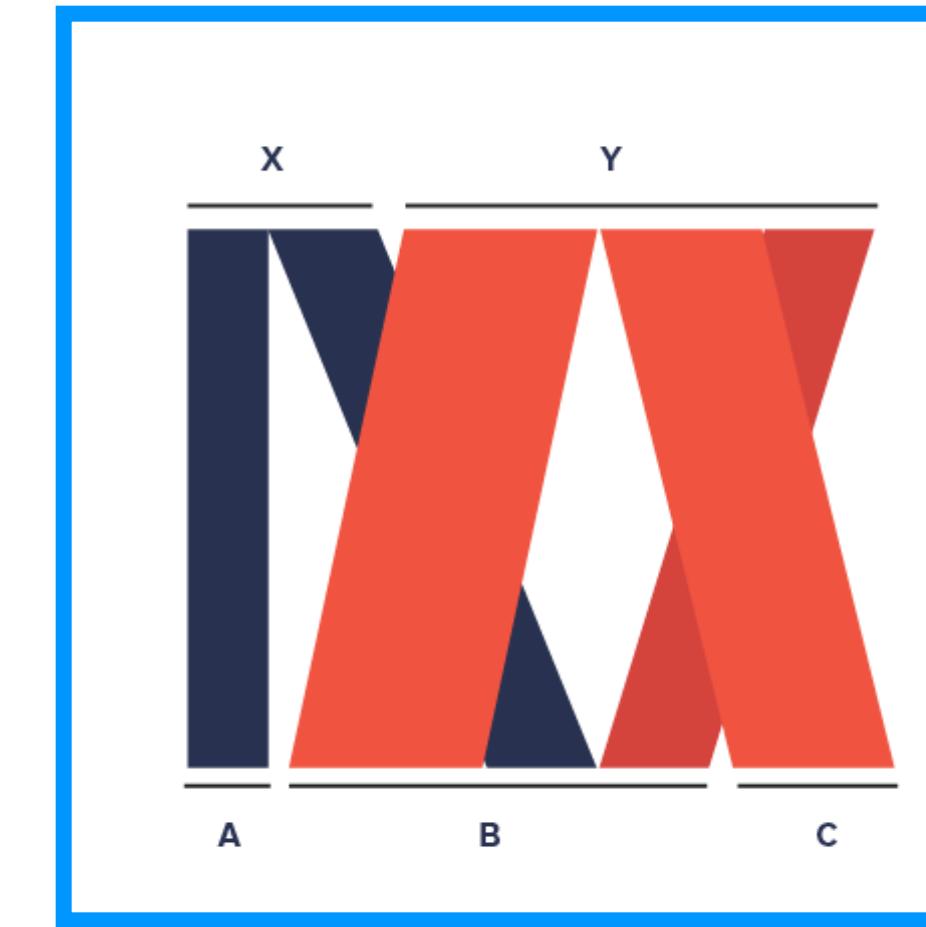
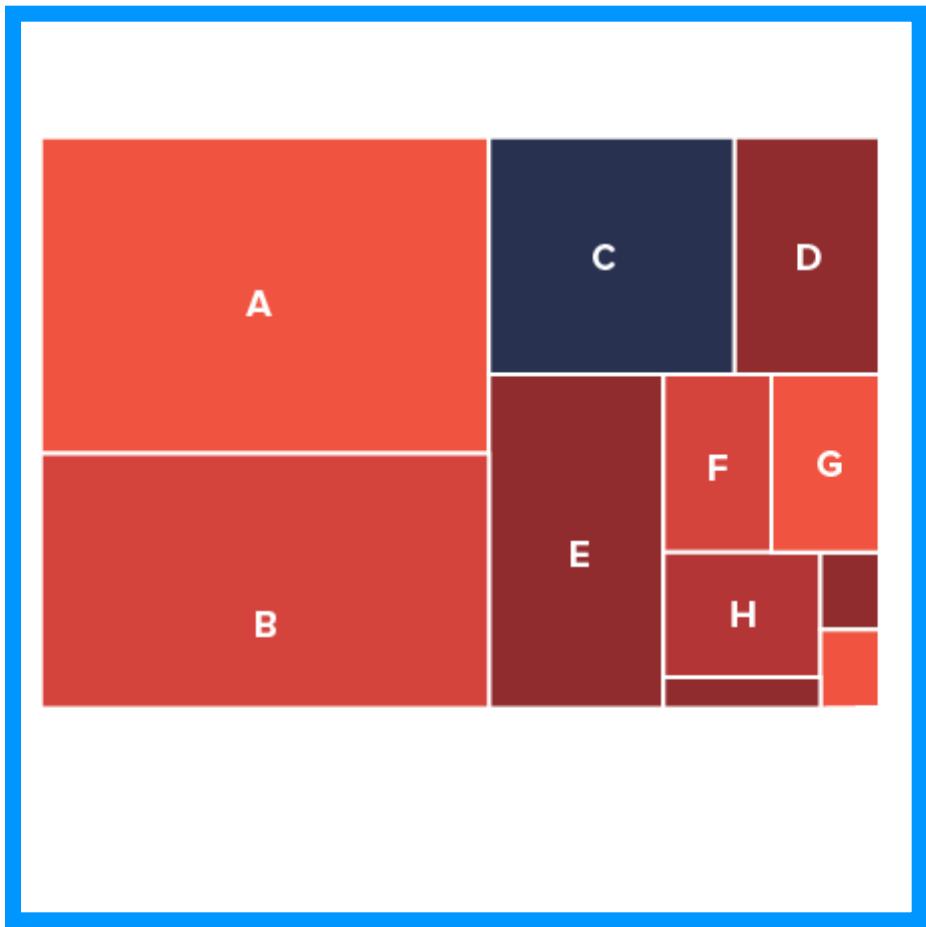
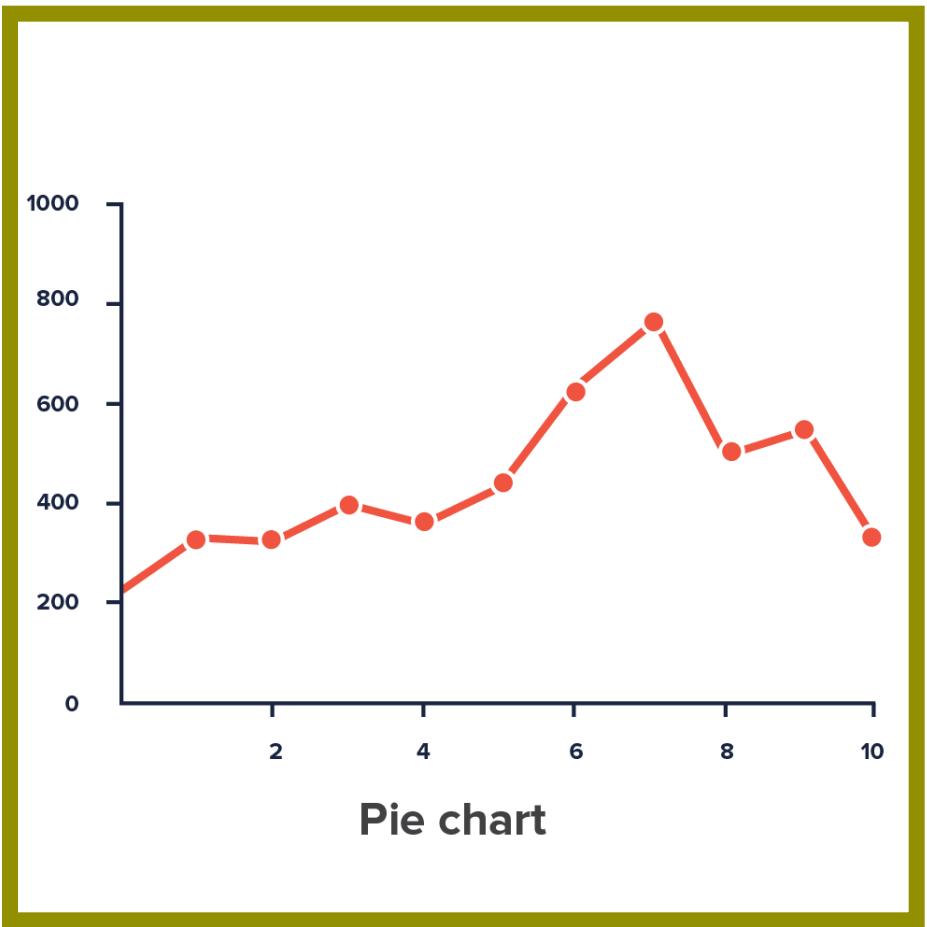
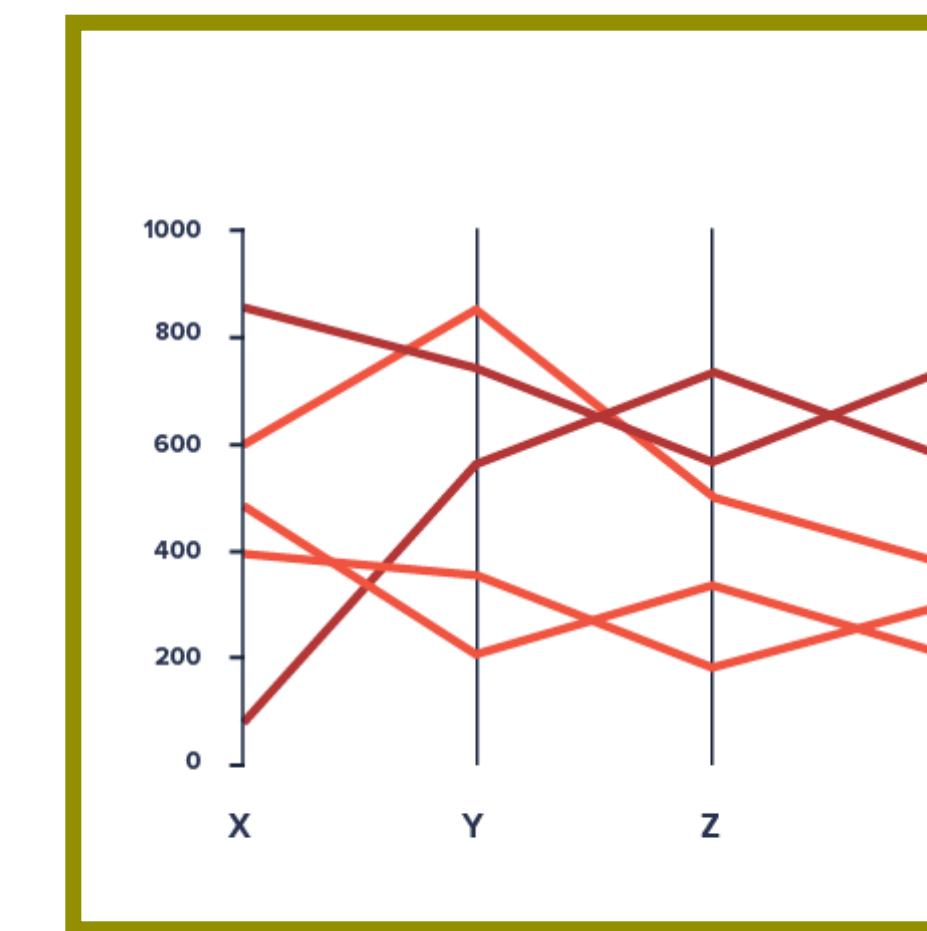
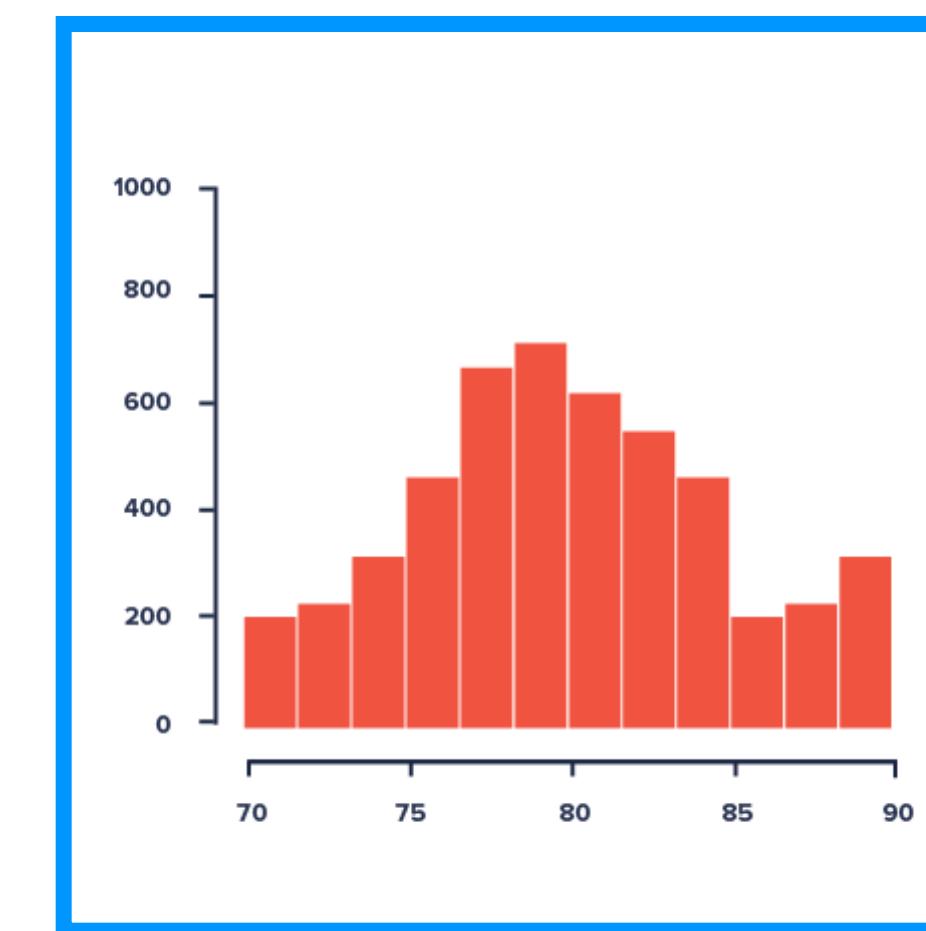
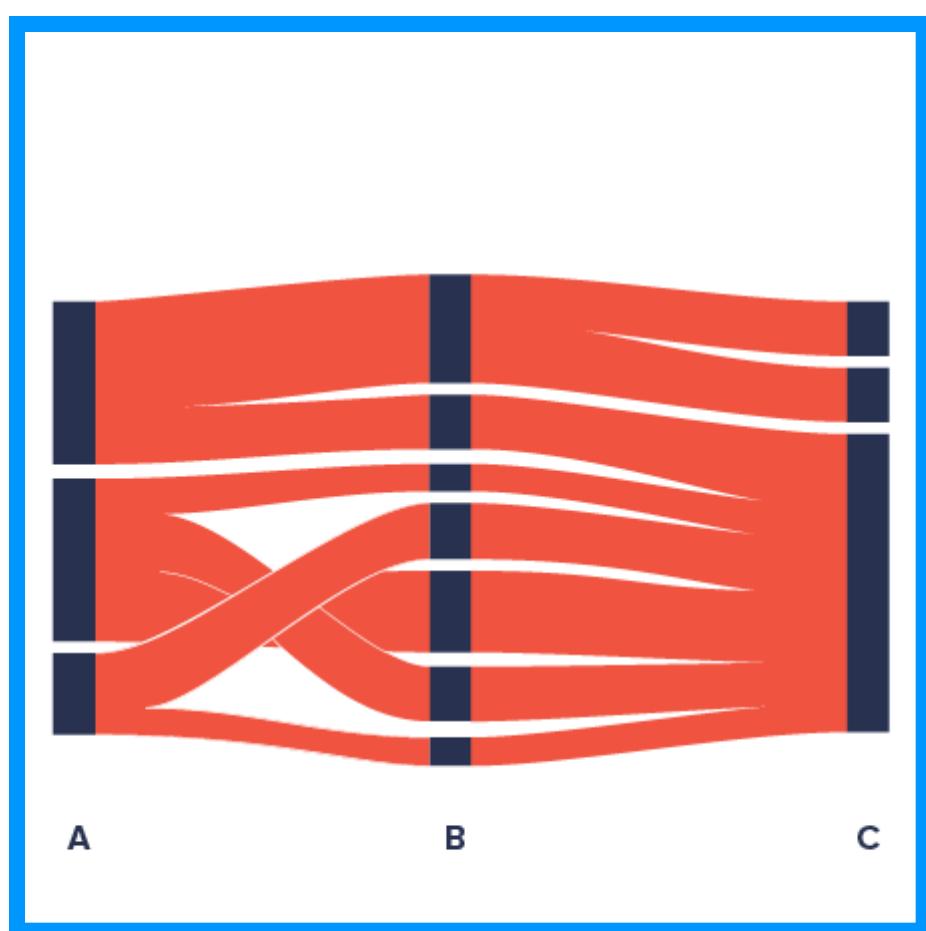
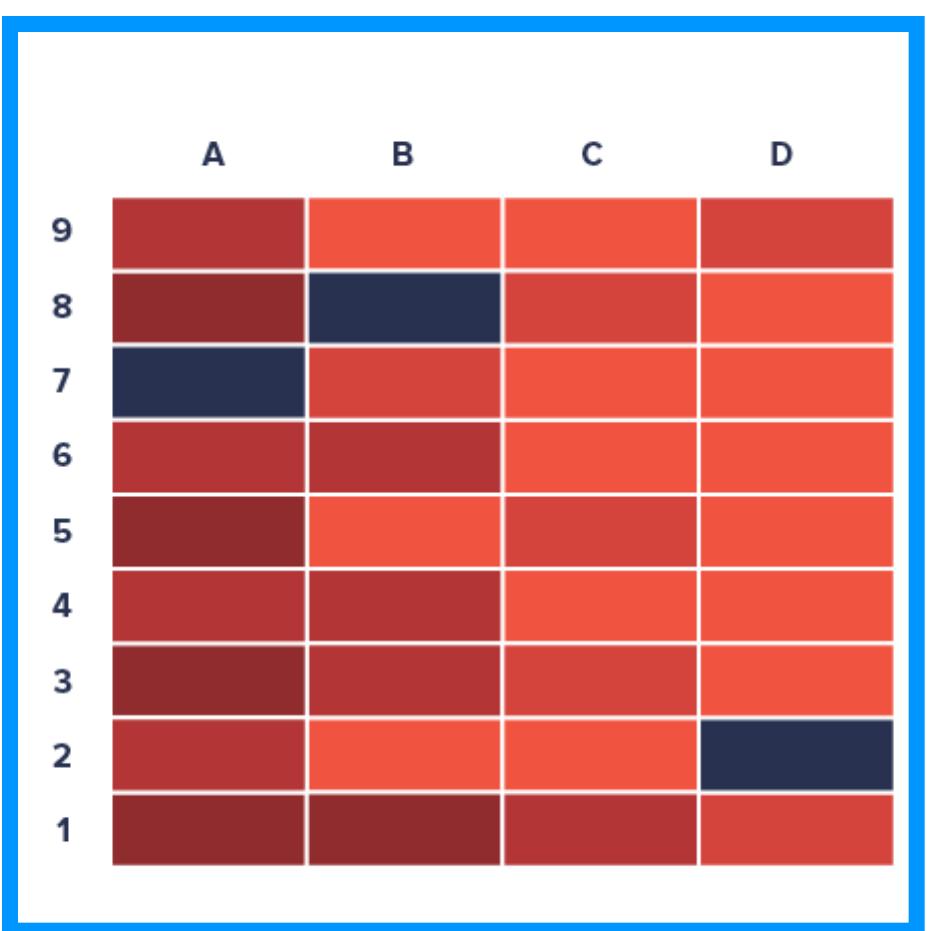
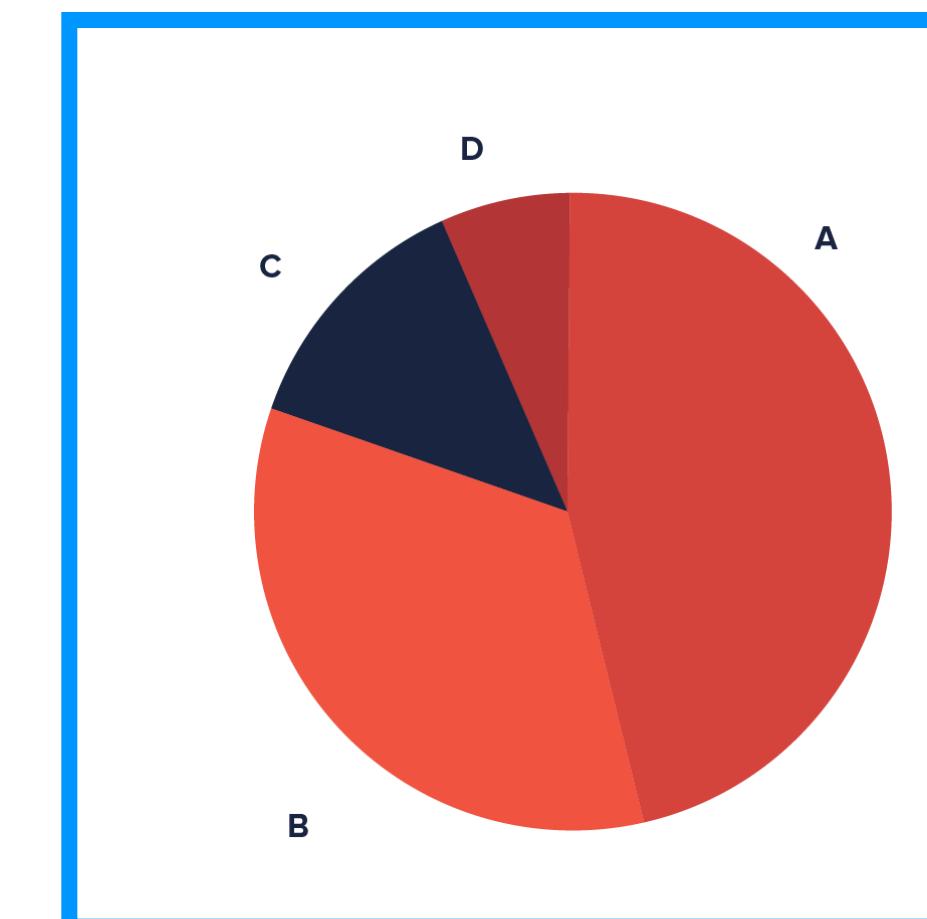
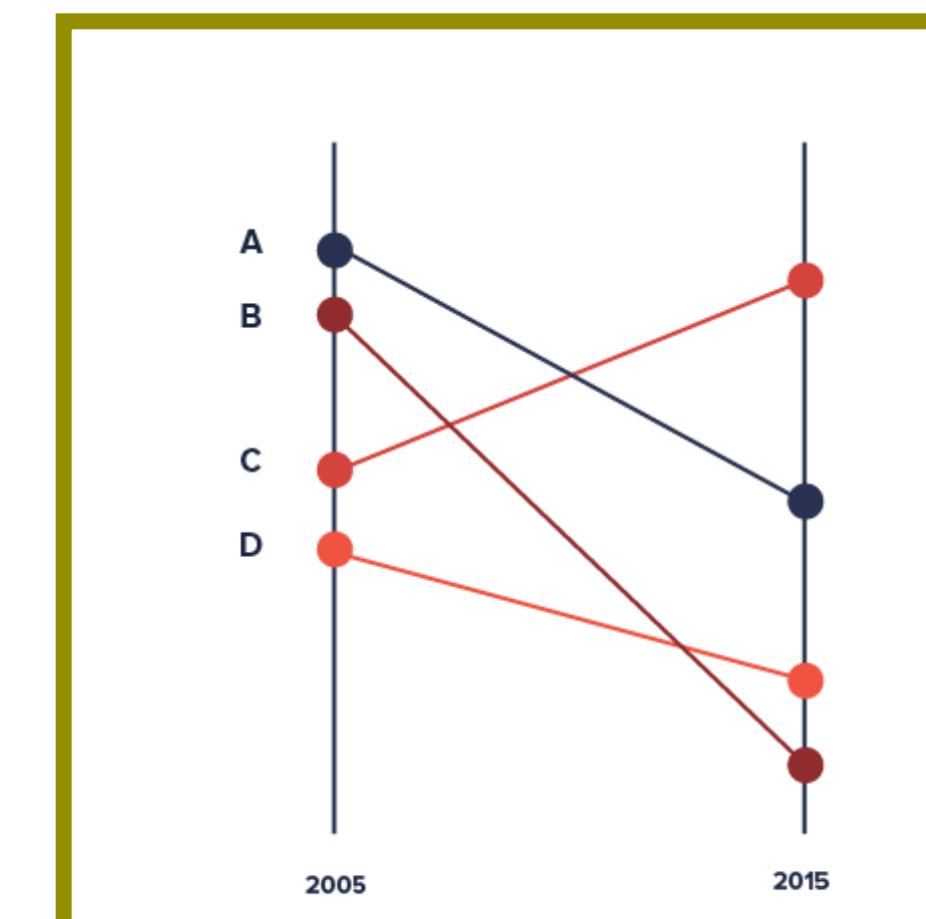
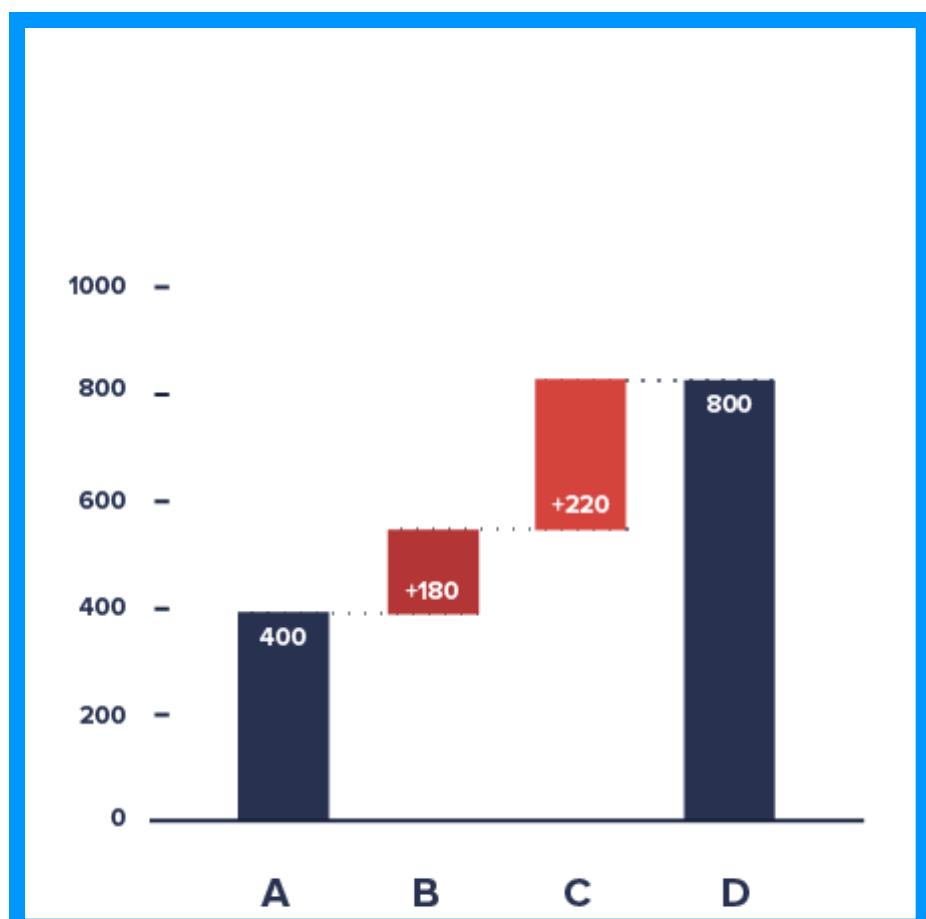
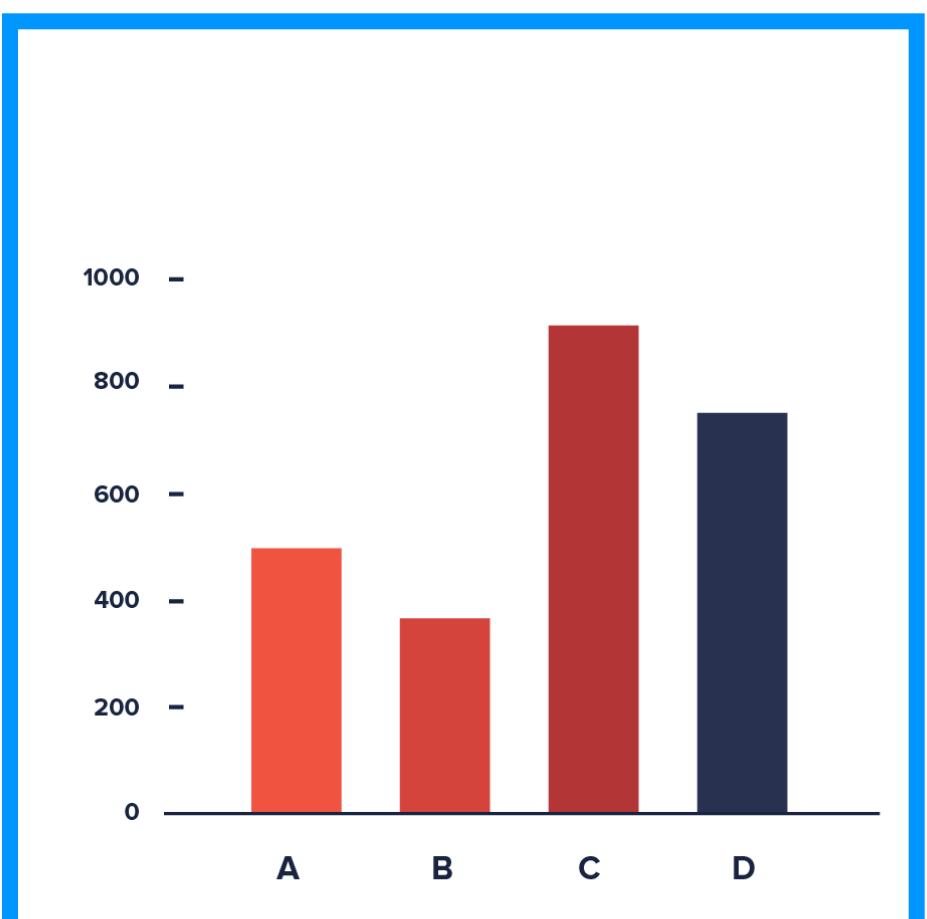
- **Grouping – Grouped vs. Ungrouped**
- Temporality
- Functions

# Ungrouped



# Grouped





# Approaches to **chart & diagram** classification

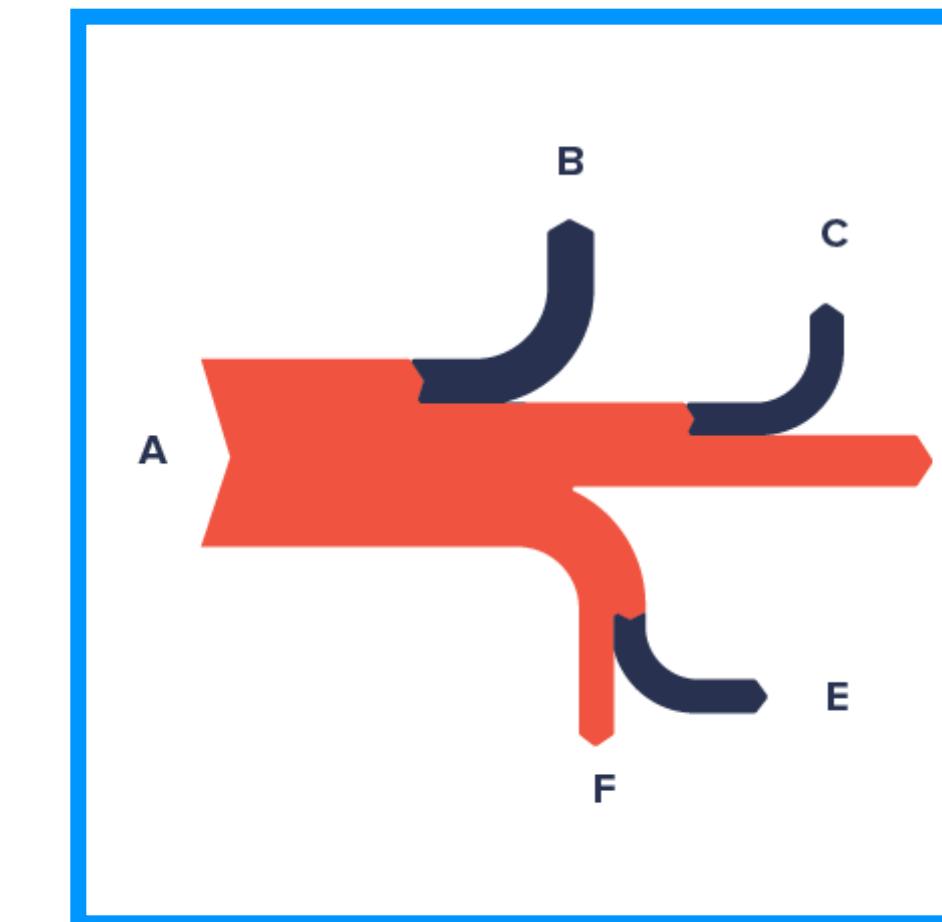
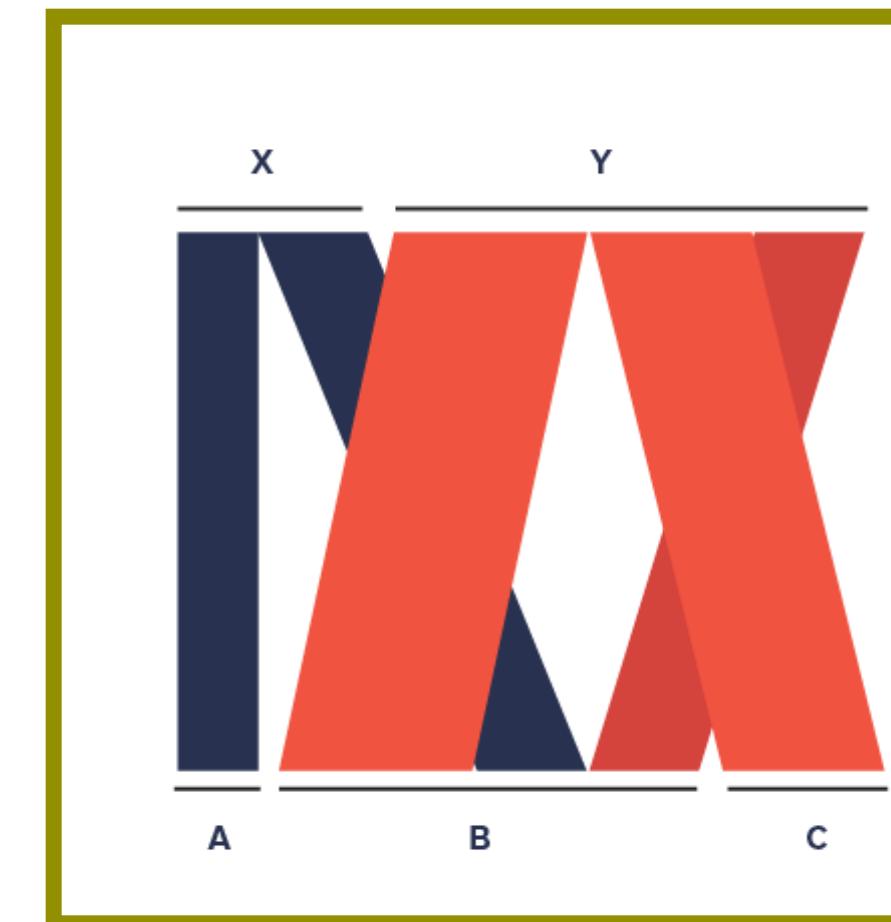
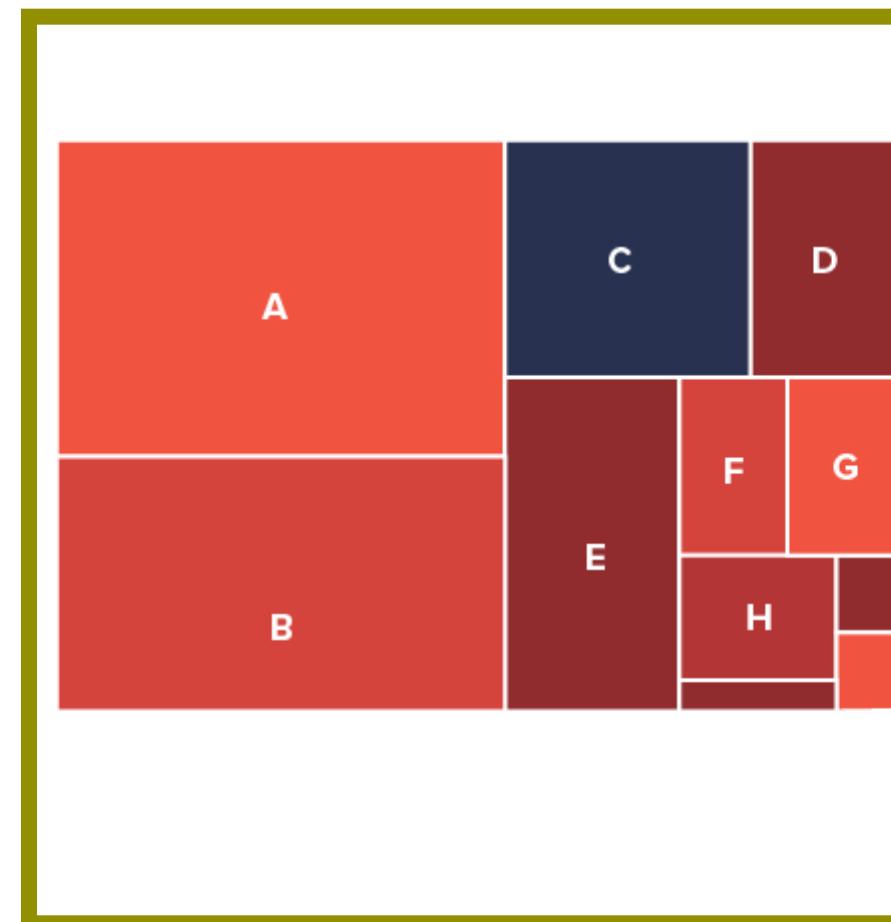
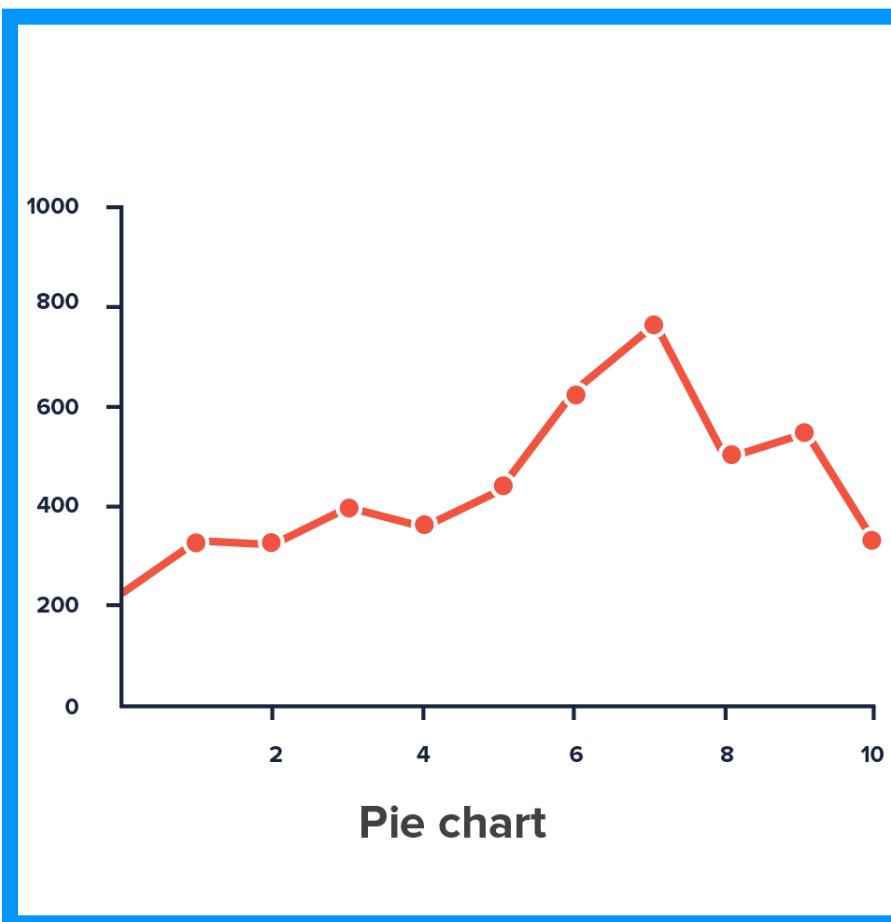
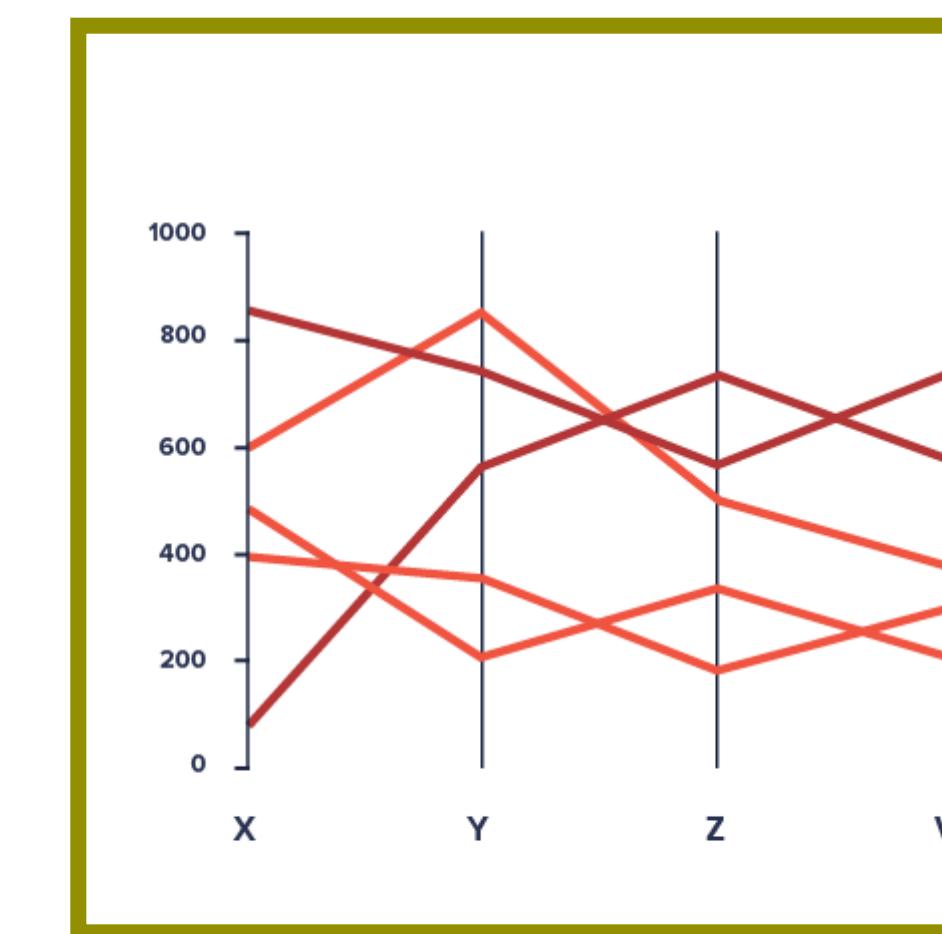
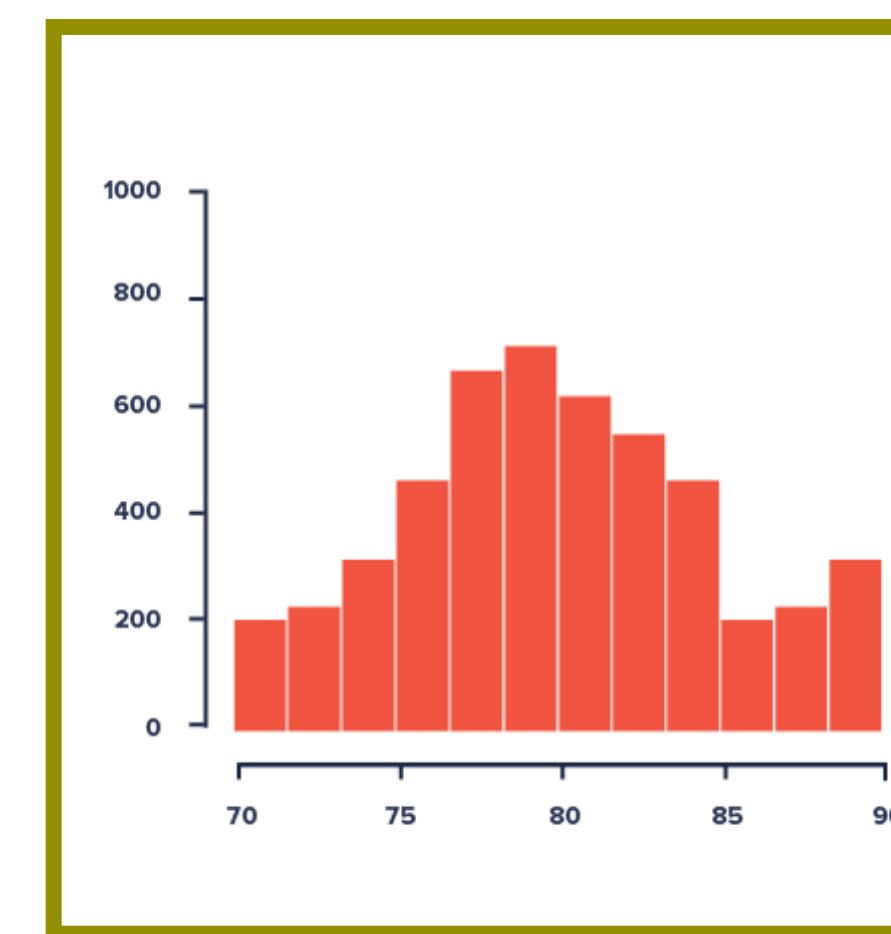
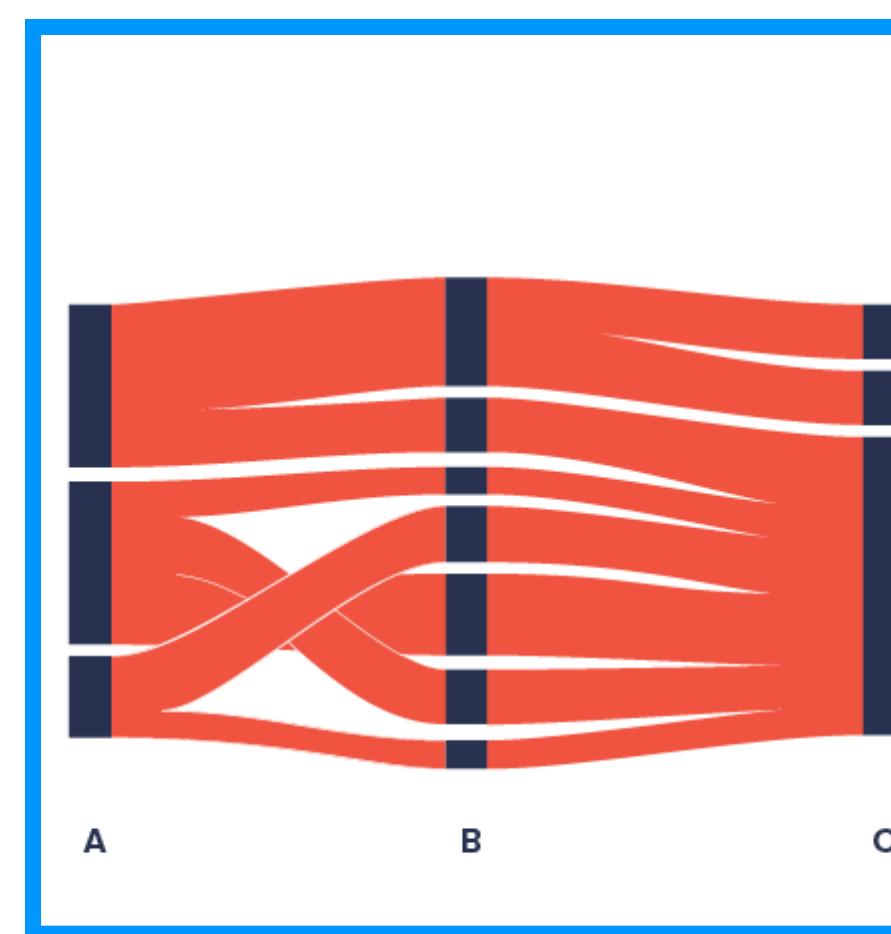
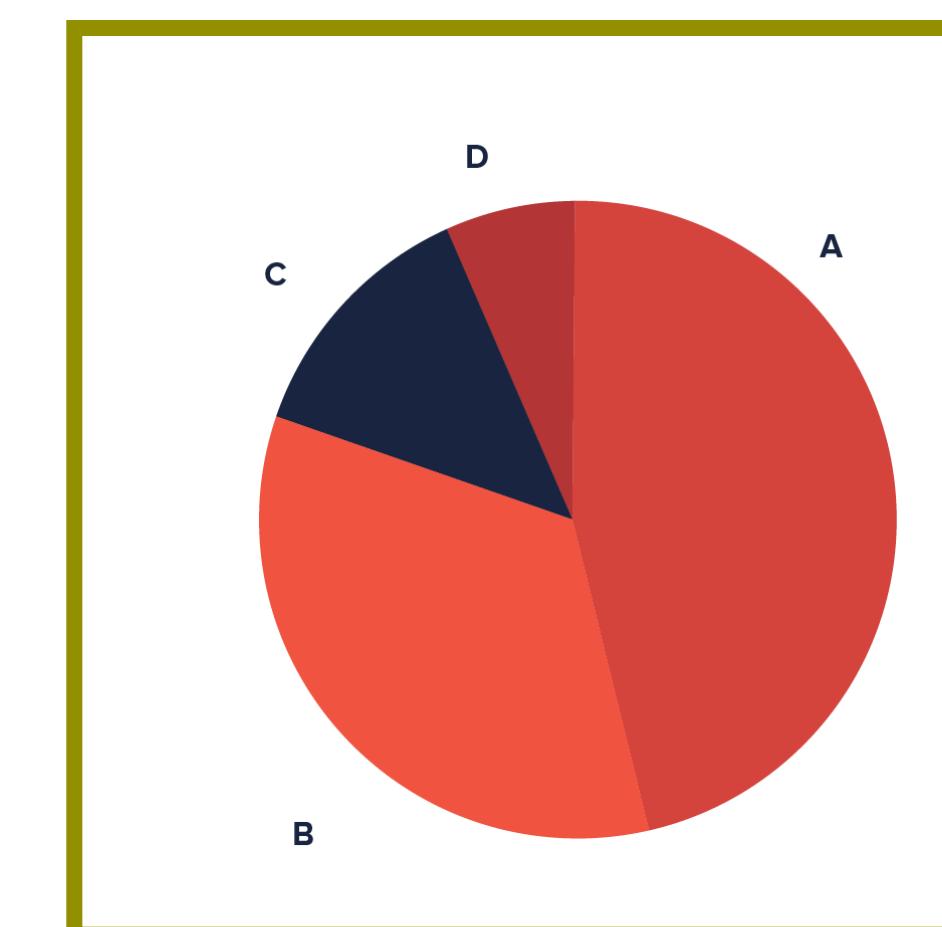
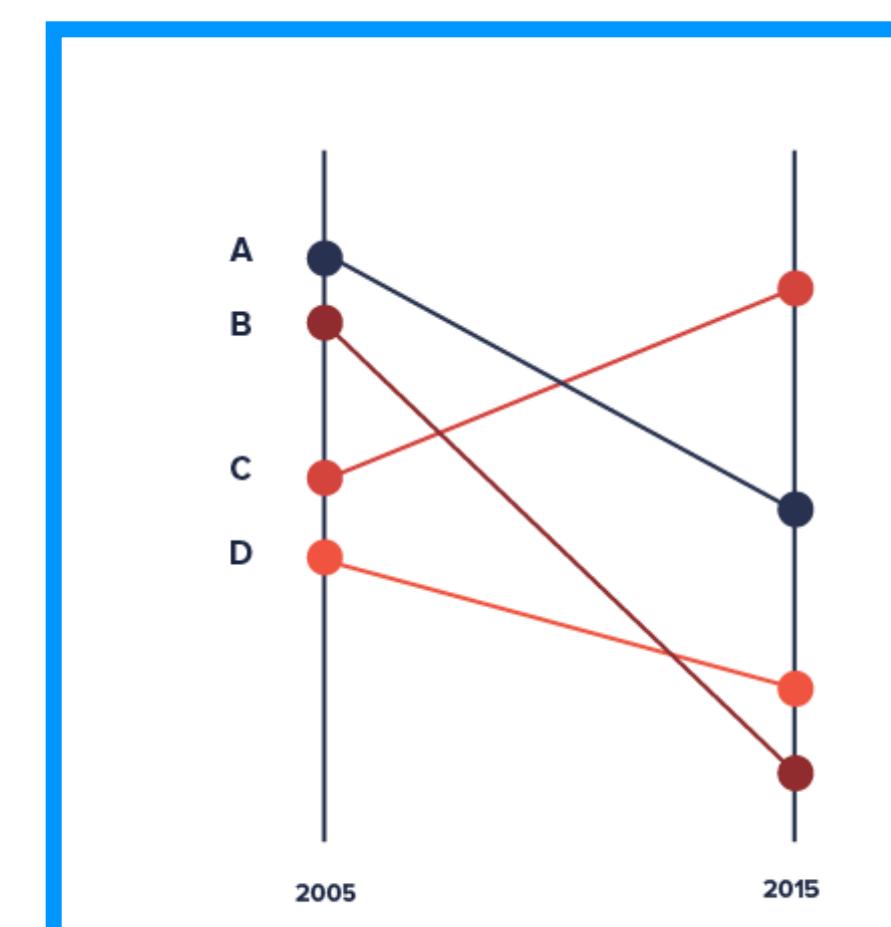
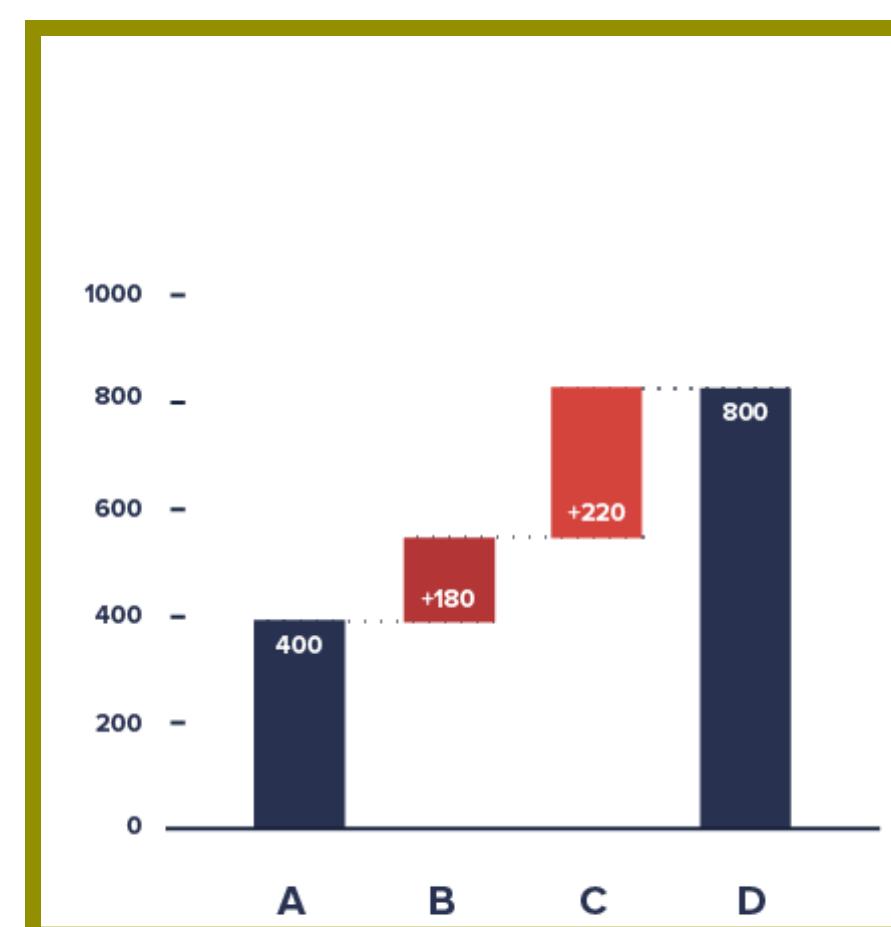
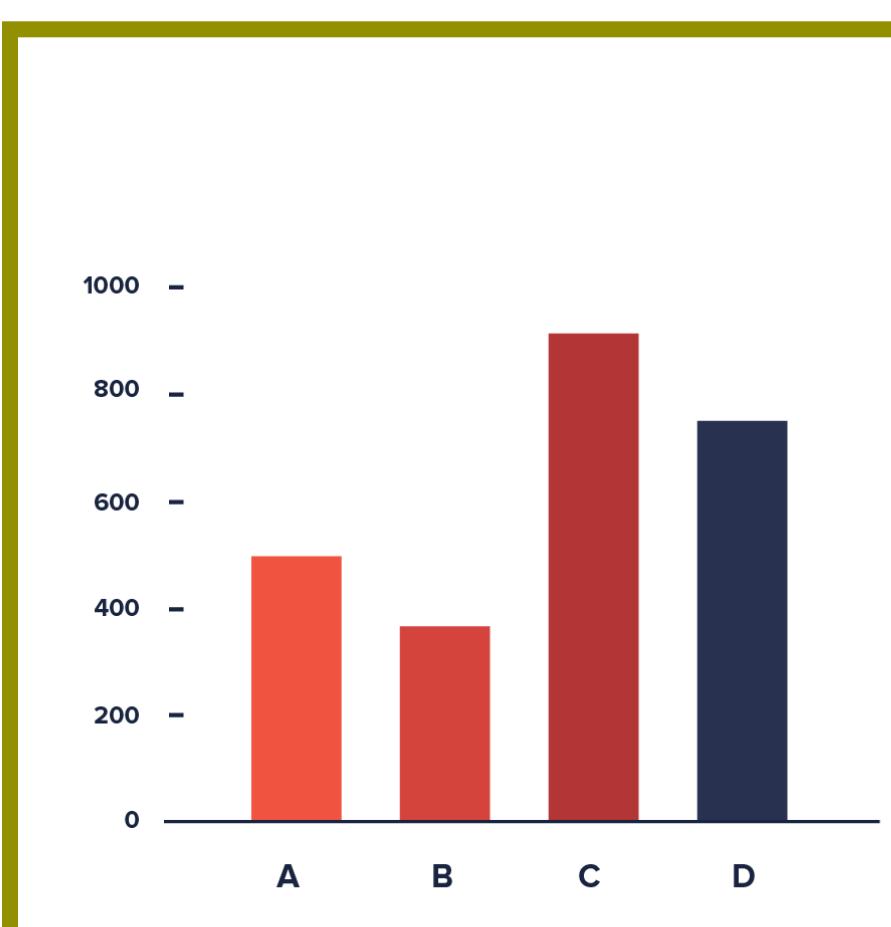
- Grouping
- **Temporality – Over time vs. snapshot**
- Functions

**Snapshot**



**Over time**

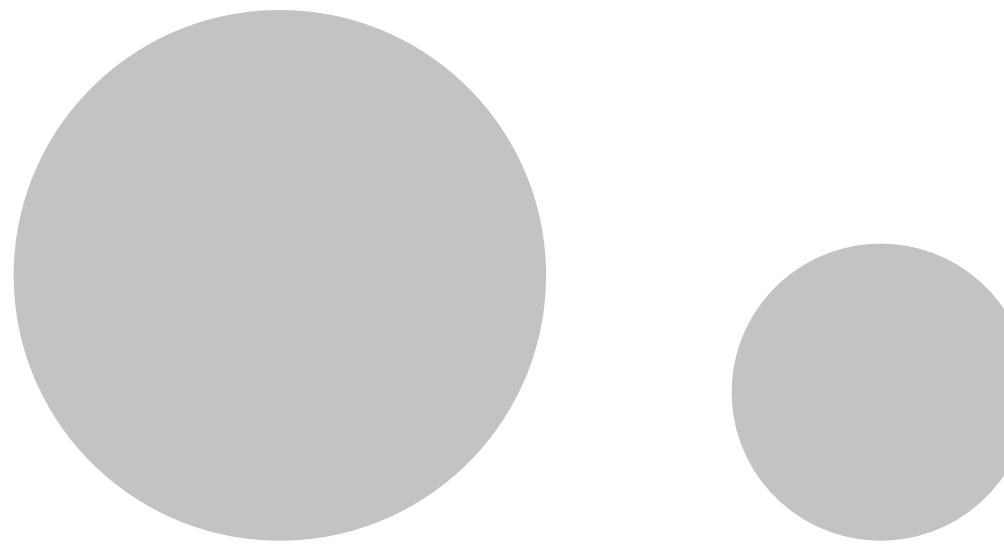




# Approaches to **chart & diagram** classification

- Grouping
- Temporality
- **Functions –** Comparison, Correlation, Distribution, Trend

# Comparison



# Correlation

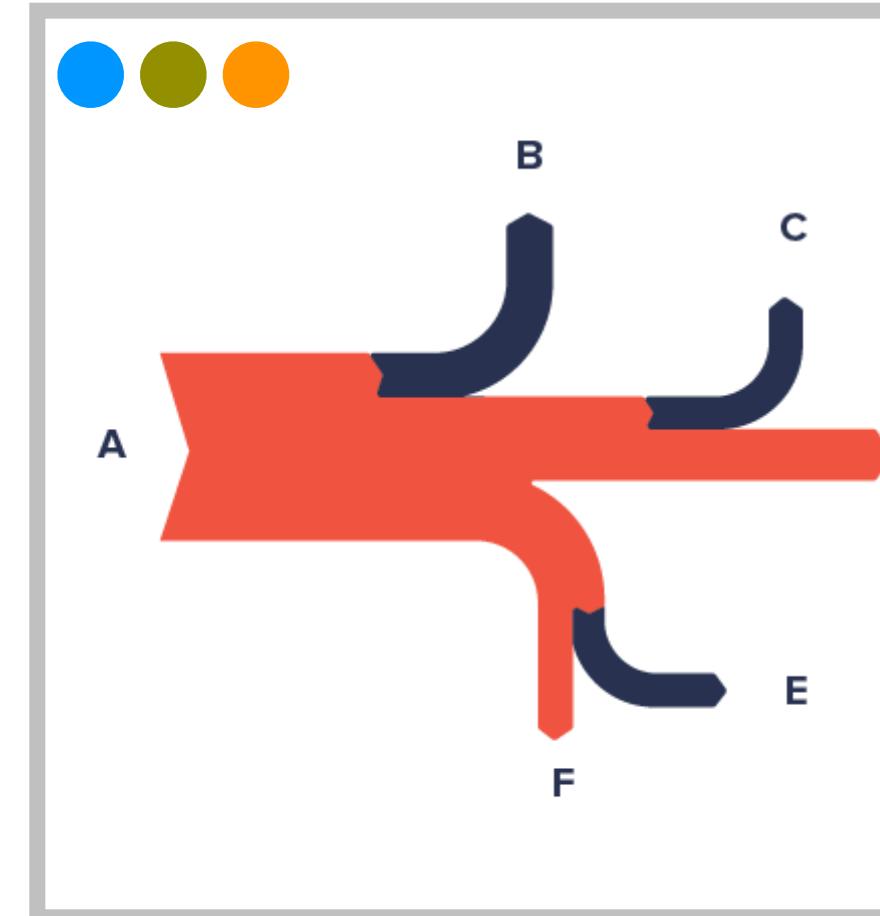
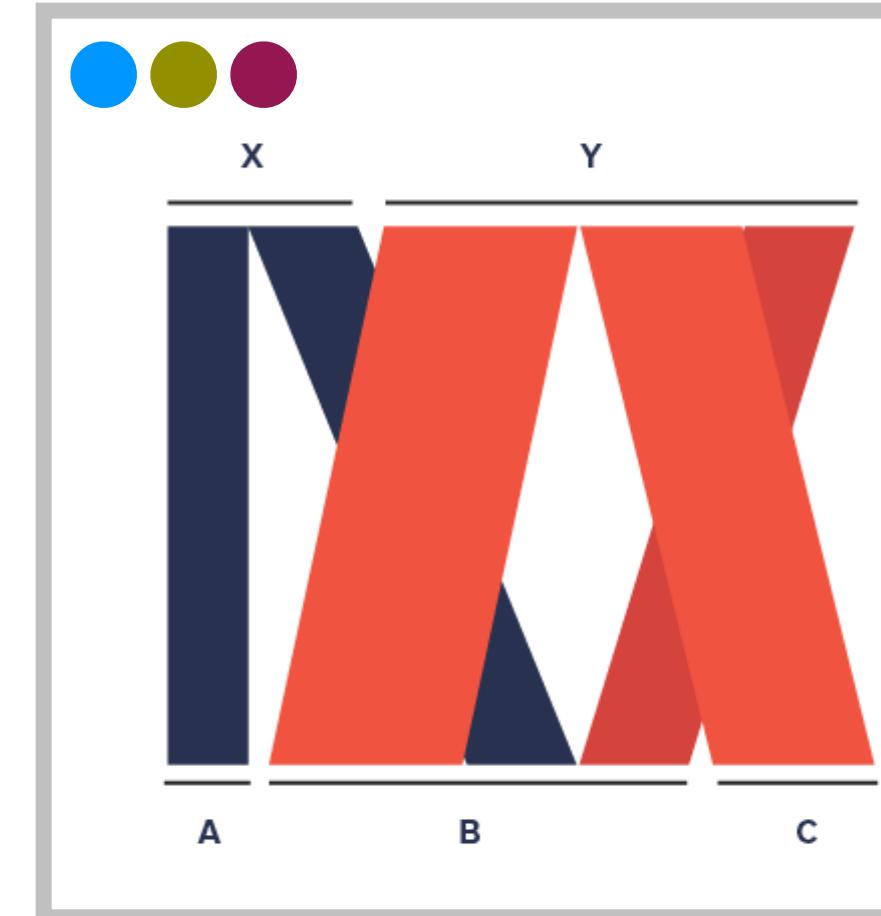
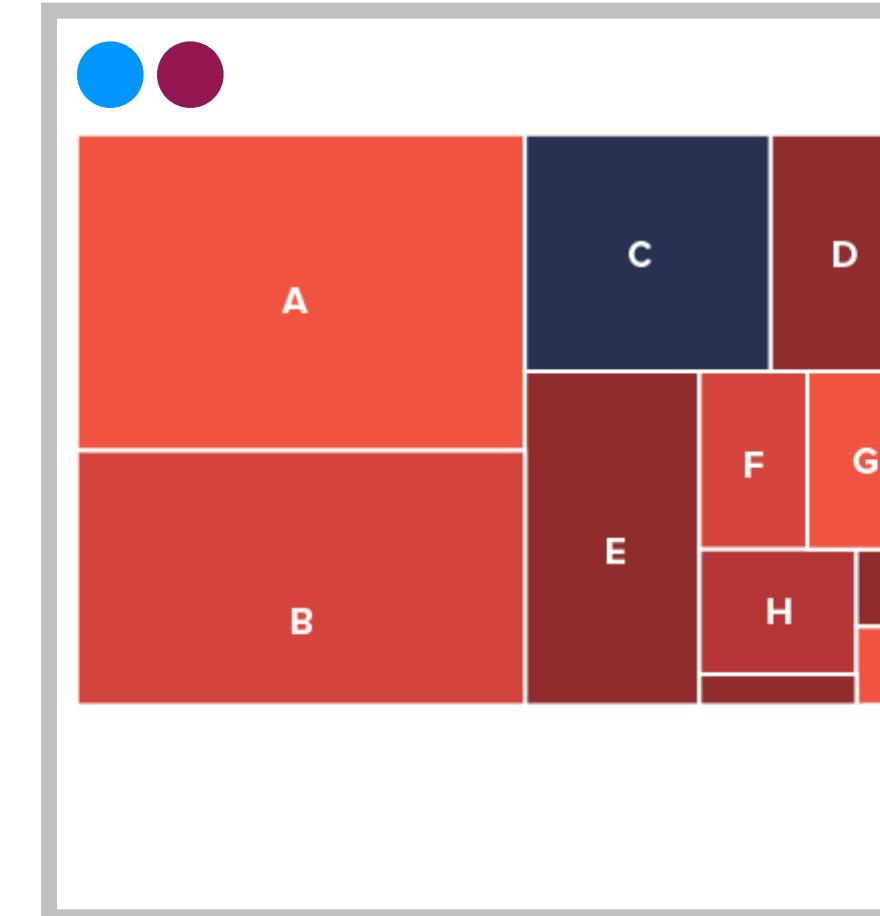
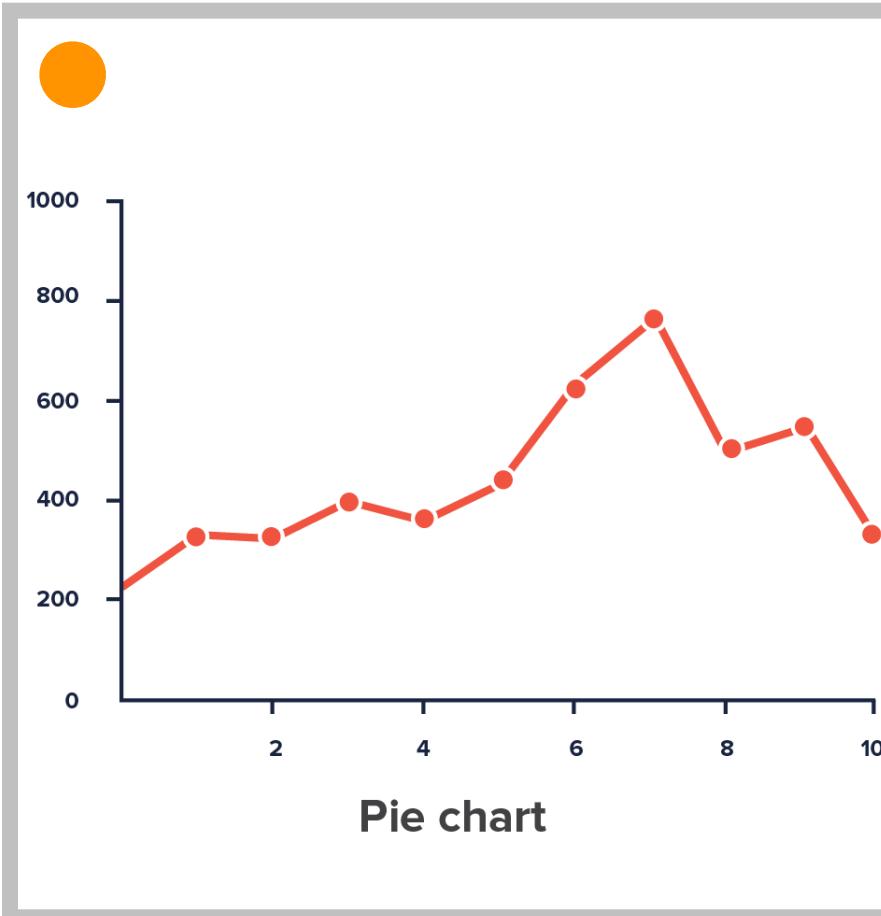
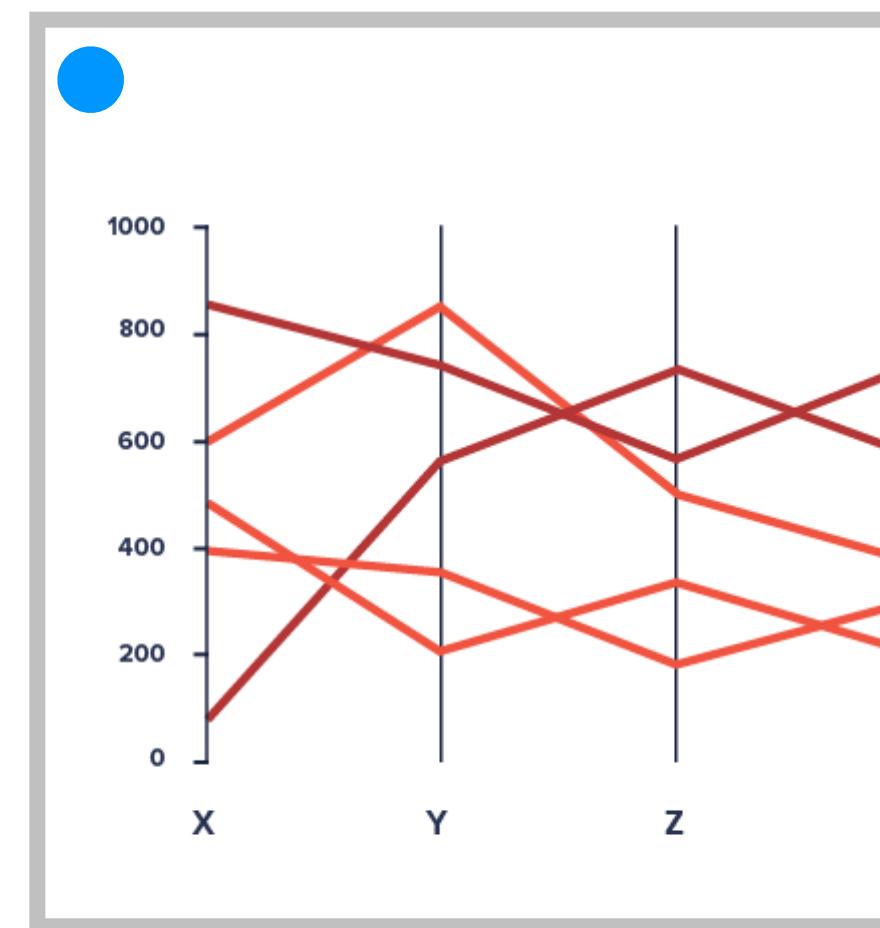
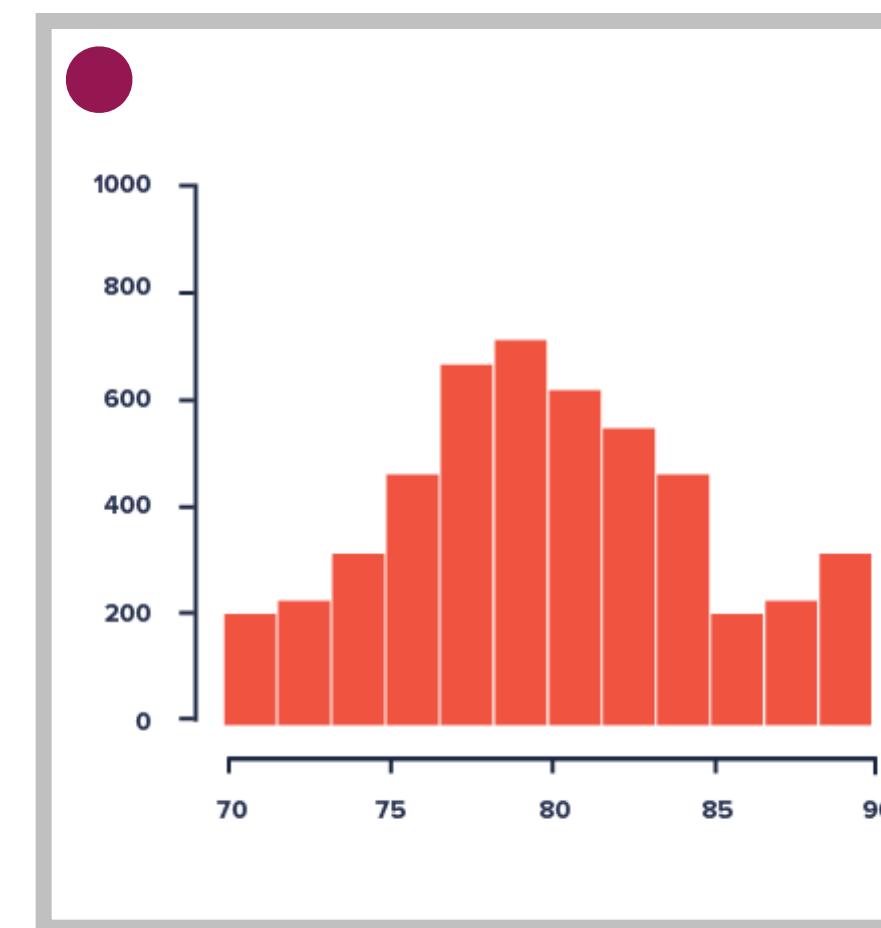
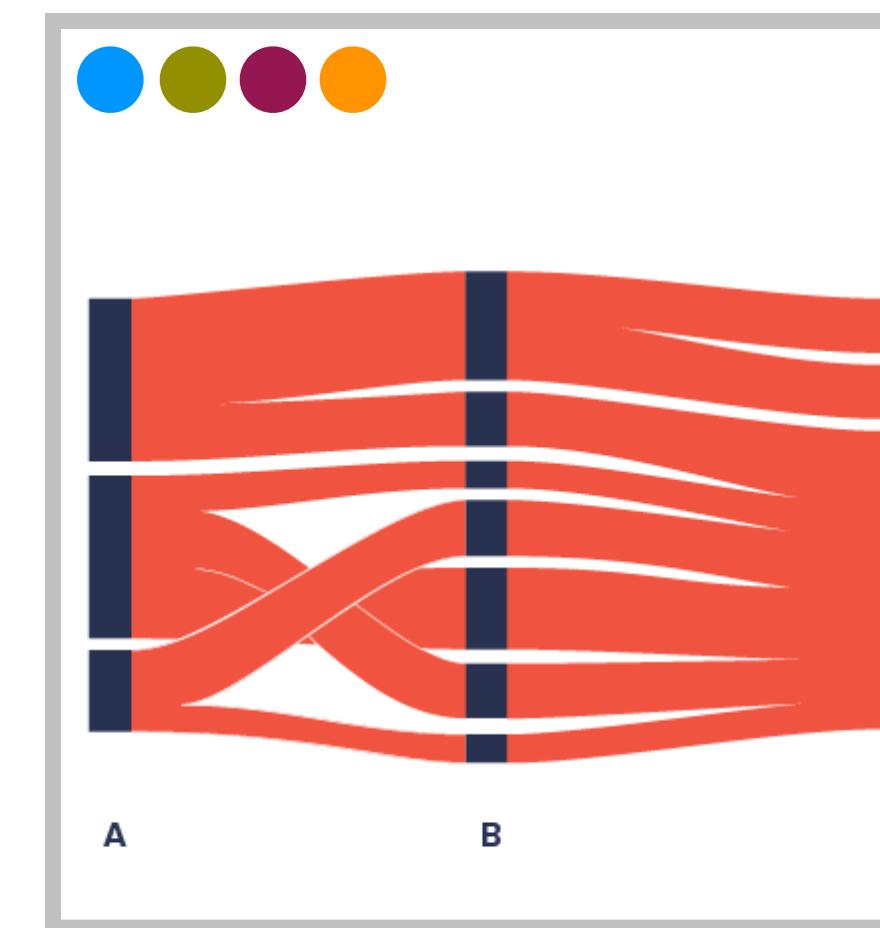
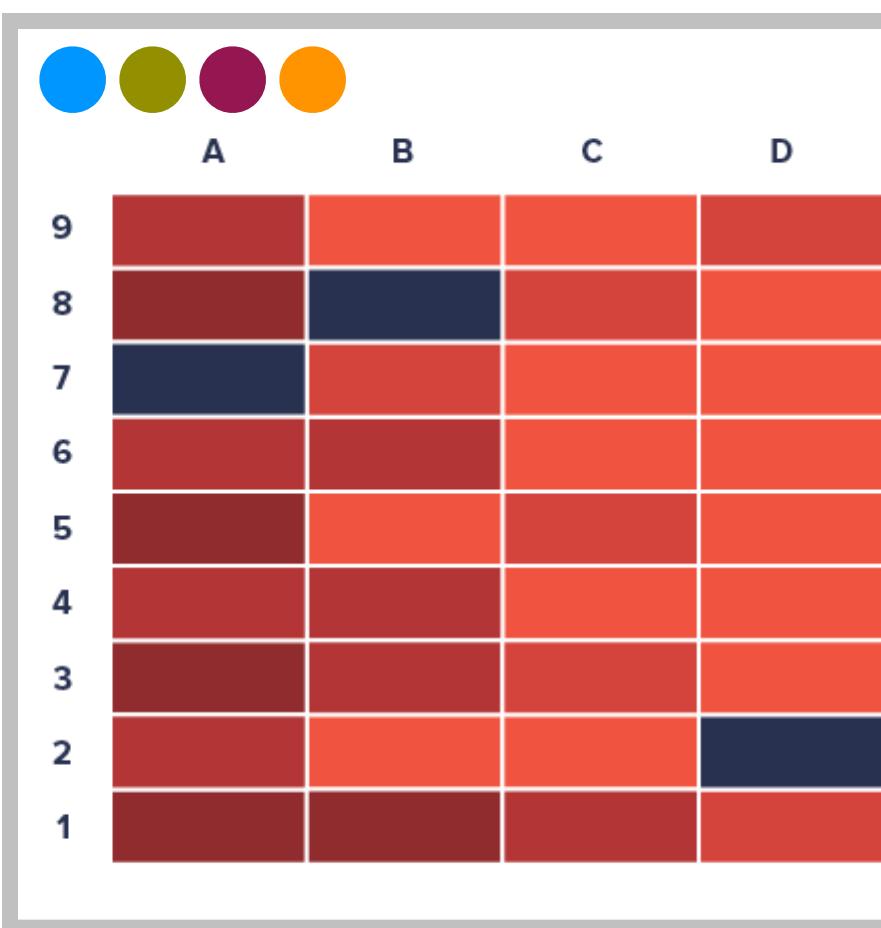
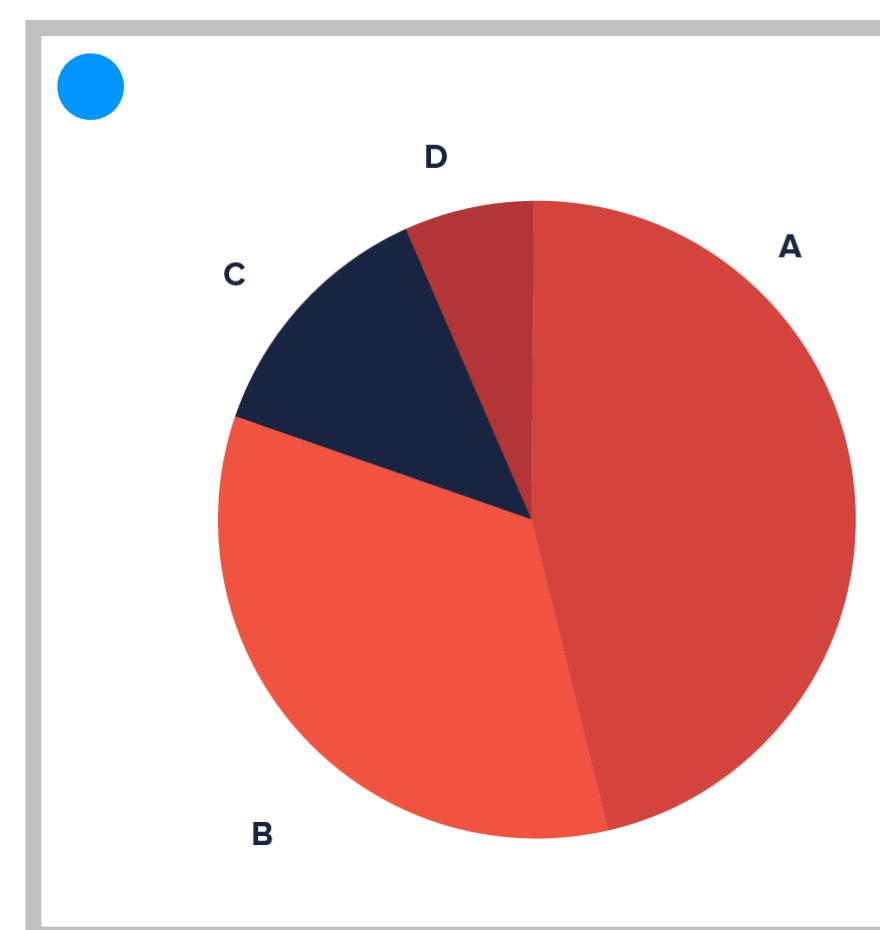
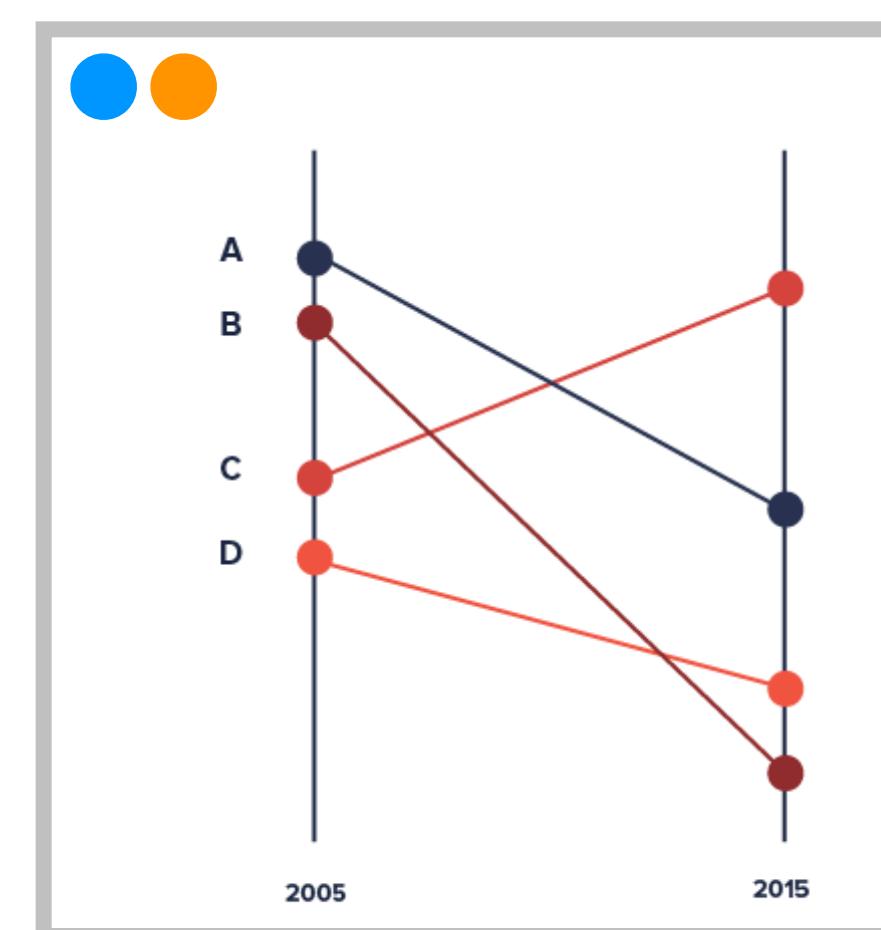
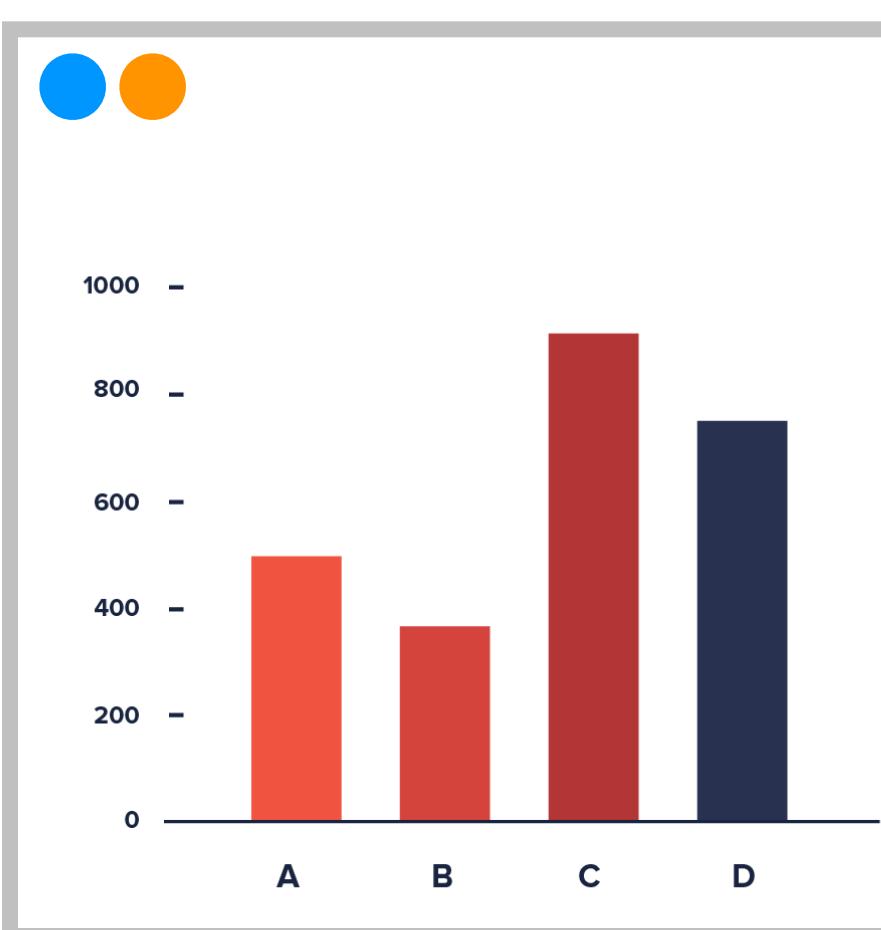


# Distribution



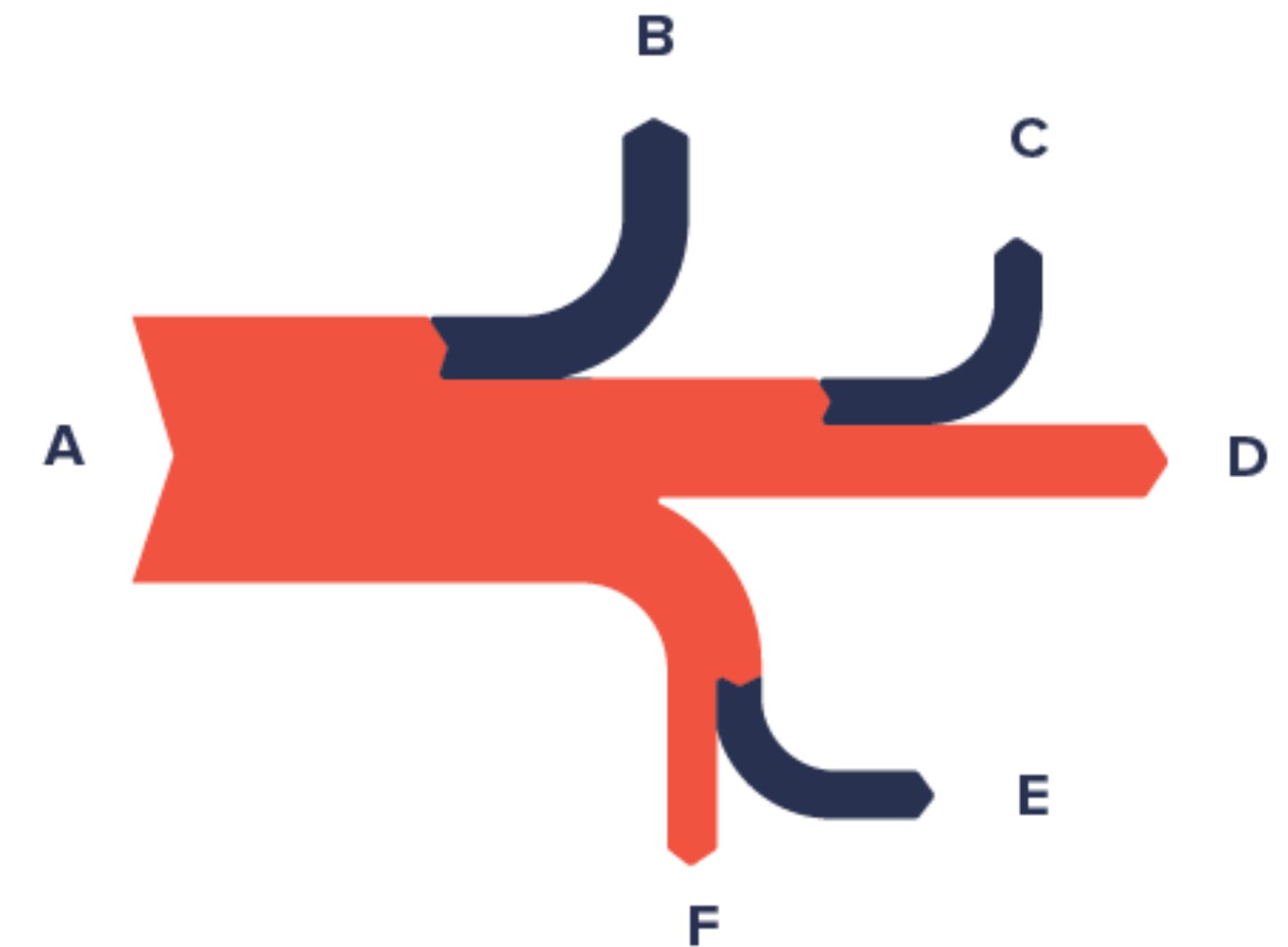
# Trend





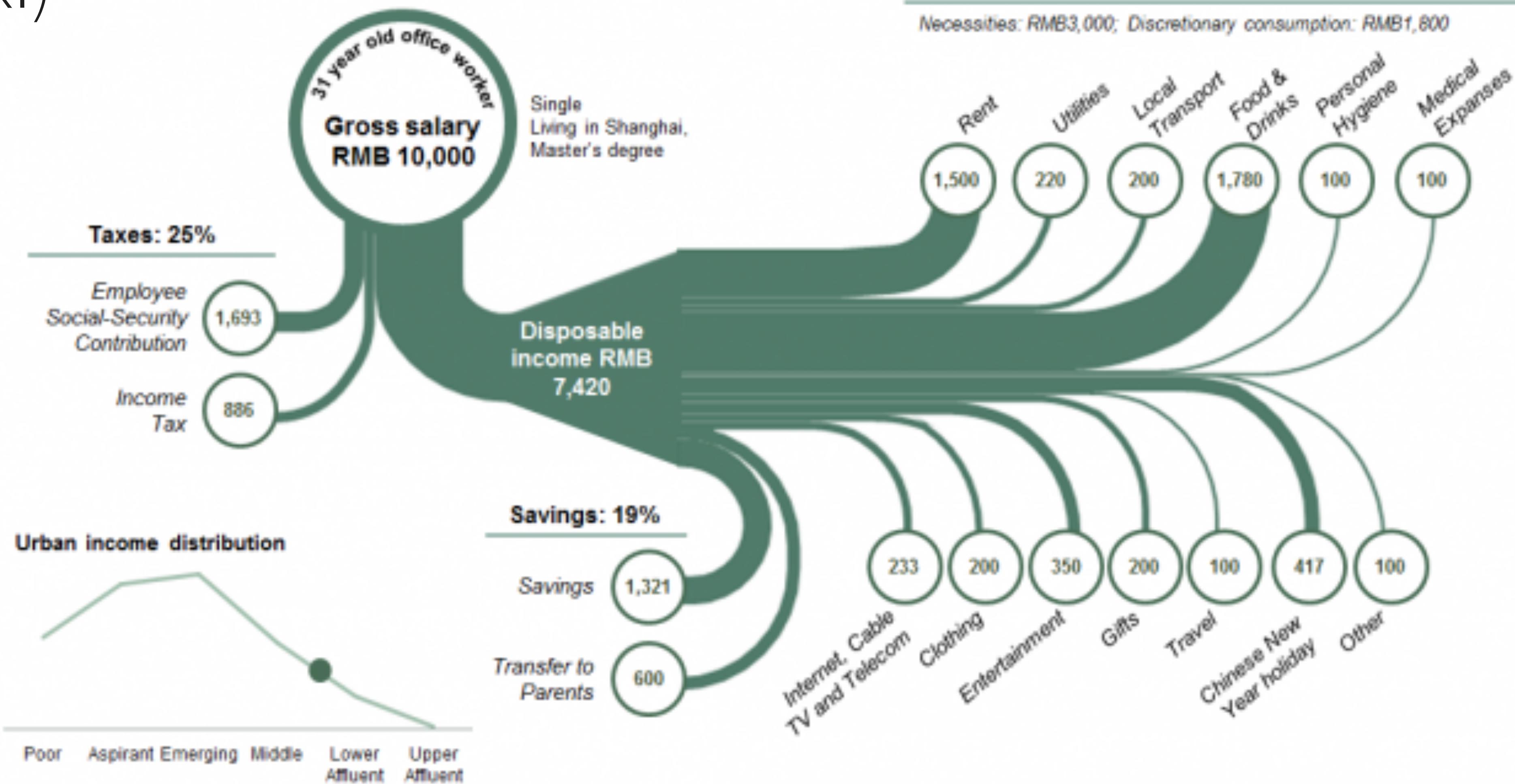
# 01 – Sankey diagram

- Flow diagram
- Arrow width = proportional to quantity
- Used to visualize overall transfers or flows within a system
- Helpful for locating dominant contributions within a flow

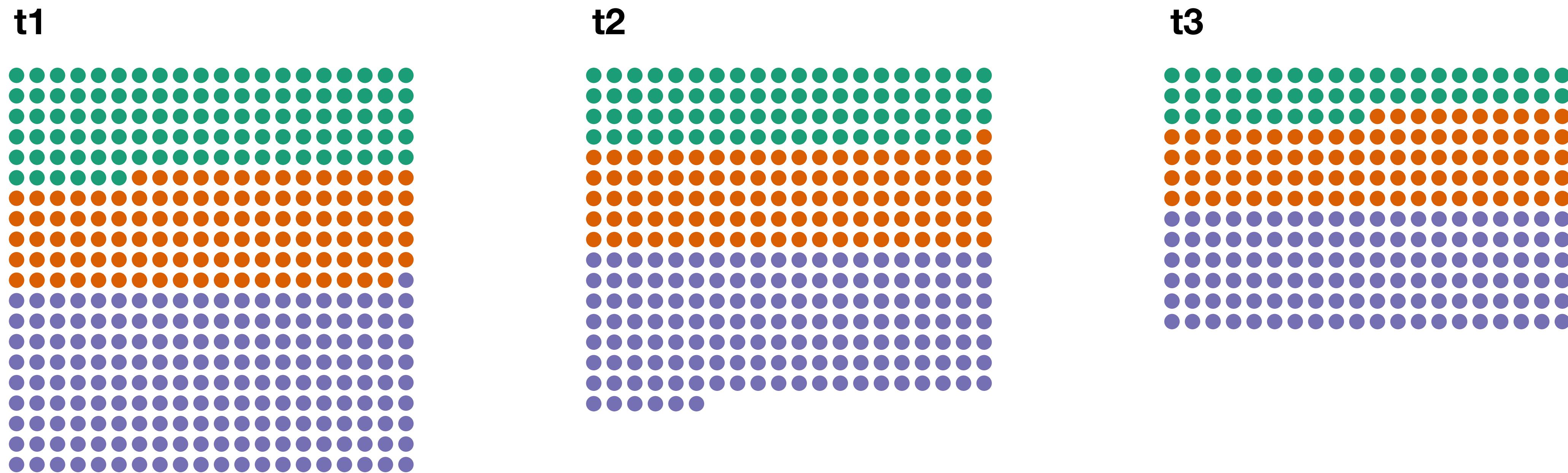


**Grouped, Over time, [ Comparison, Correlation, Trend ]**

(ex.)

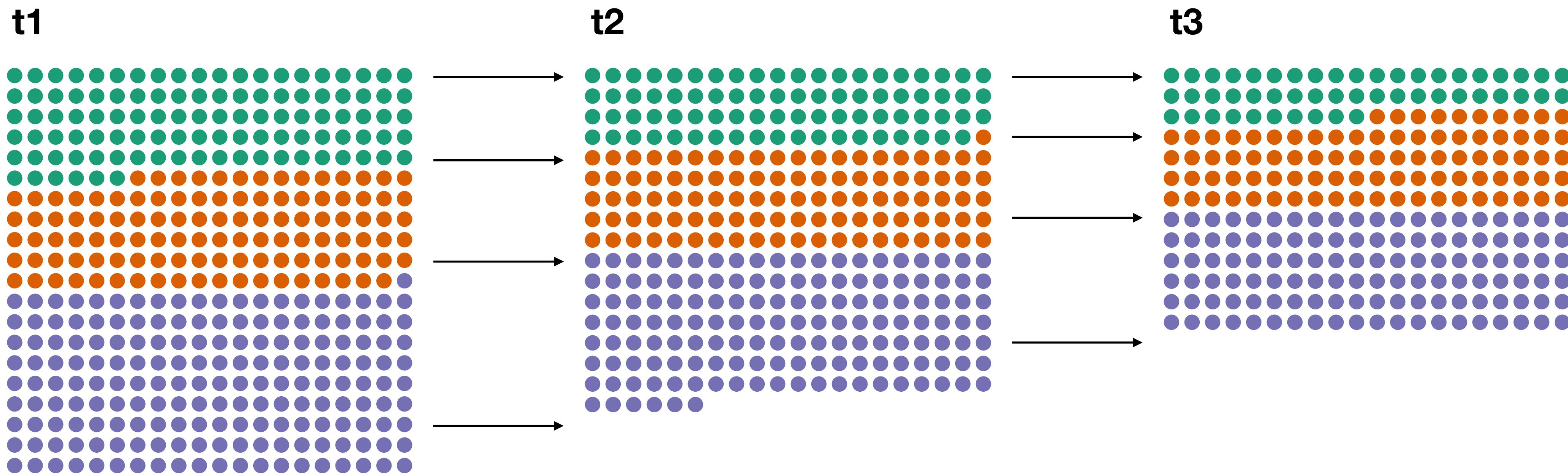


# 01 – Sankey diagram



**Grouped, Over time**

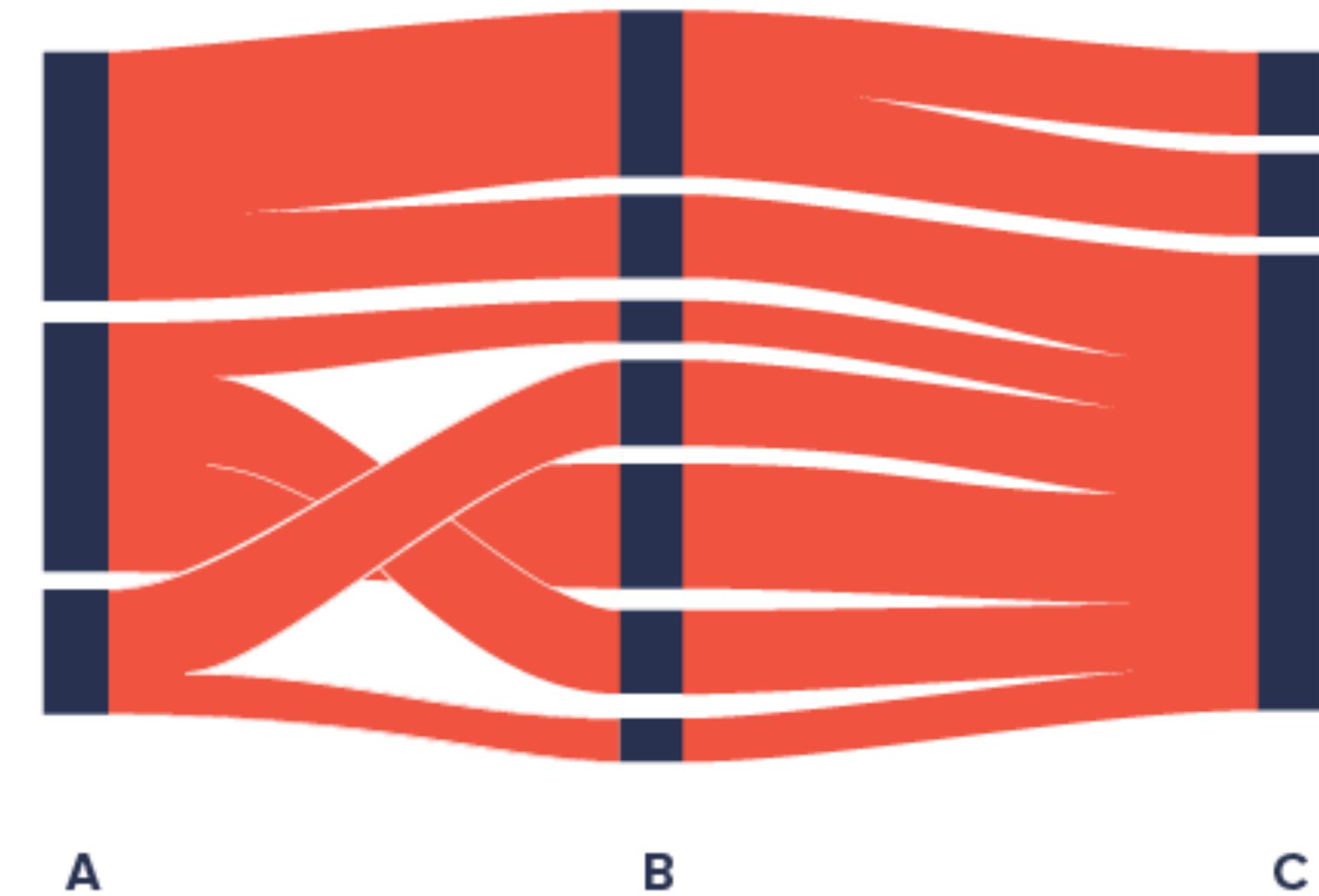
# 01 – Sankey diagram



**Grouped, Over time**

# 02 – Alluvial diagram

- Flow diagram
- Vertical, parallel axes
- Block height = size of cluster
- Height of stream field represents size of components contained in both blocks



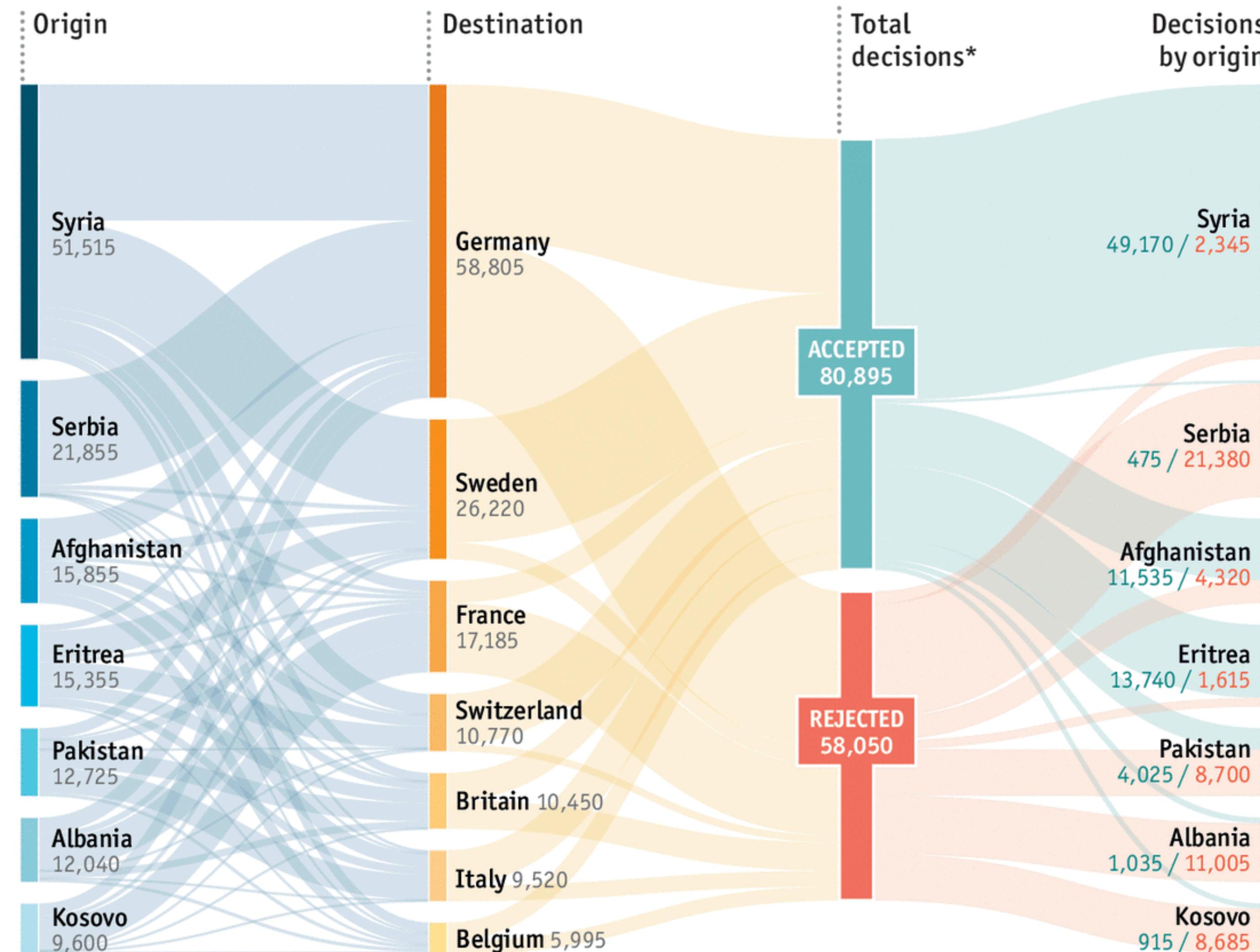
**Grouped, Over time, [ Comparison, Correlation, Distribution, Trend ]**

## European asylum seeker application decisions

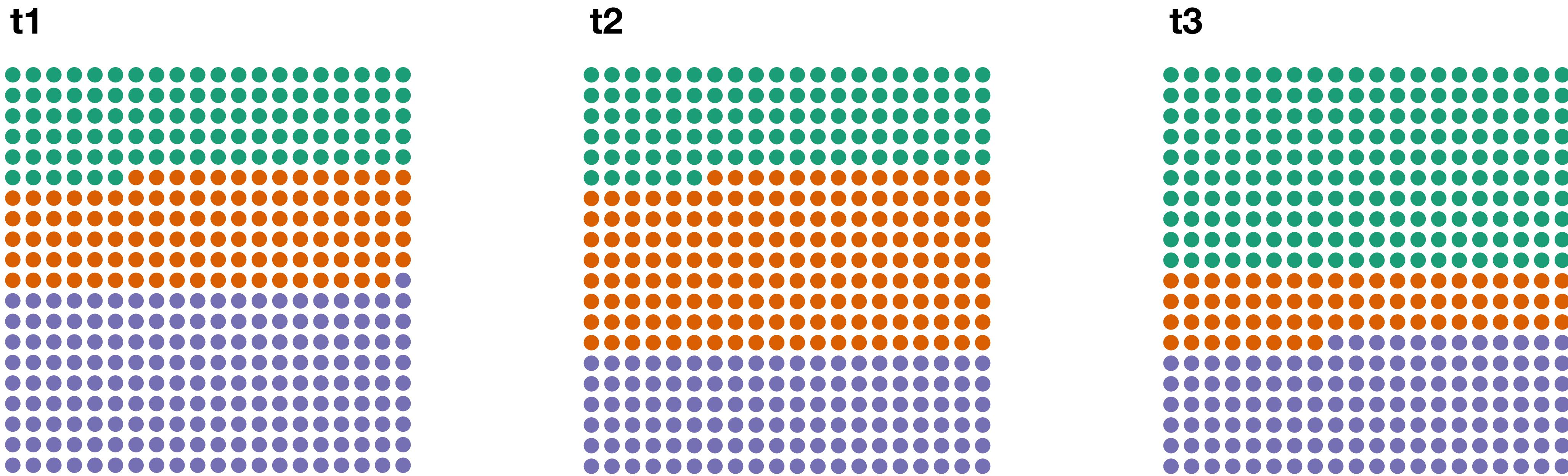
Main origin and destination countries

(ex.)

2014

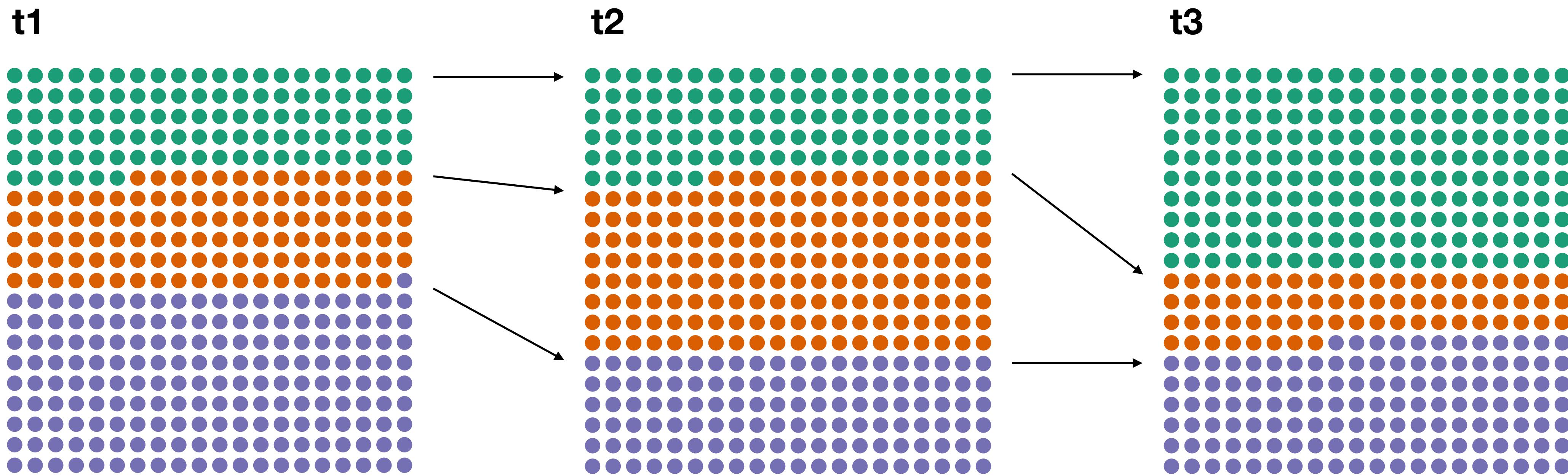


# 02 – Alluvial diagram



**Grouped, Over time**

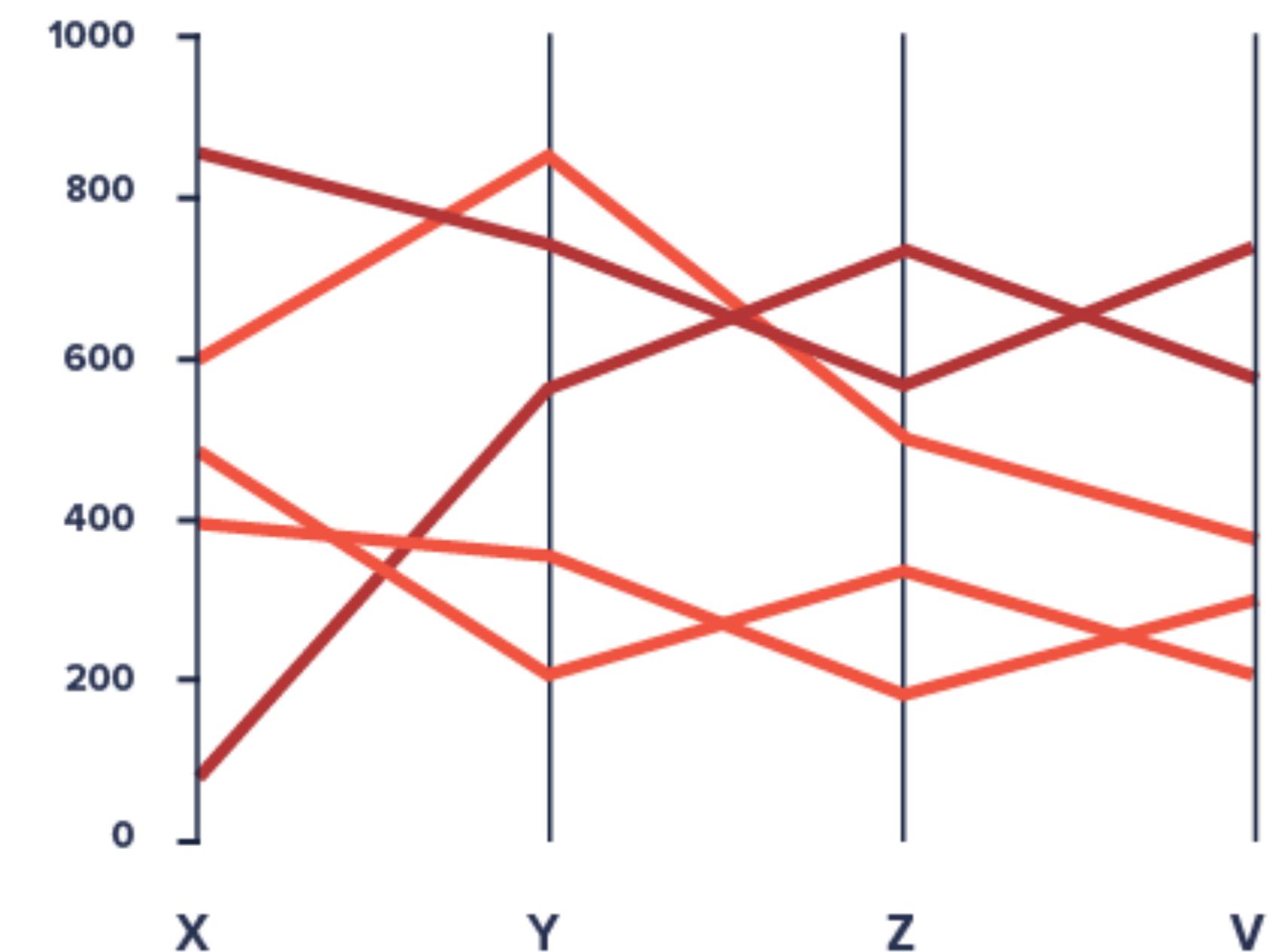
# 02 – Alluvial diagram



**Grouped, Over time**

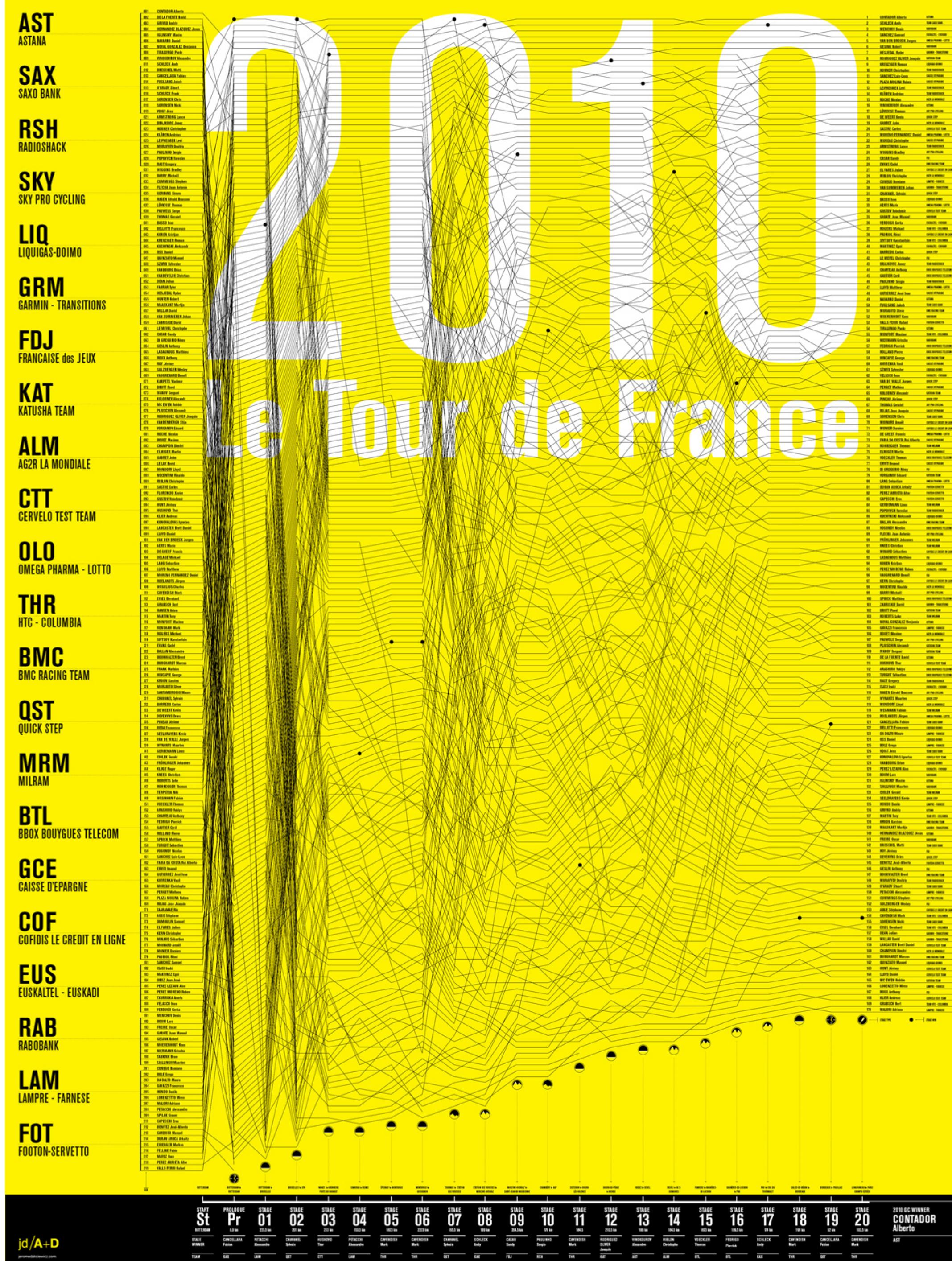
# 03 — Parallel coordinates

- Common for visualizing high-dimensional, multivariate data
- Vertical axes representing different attributes
- Closely related to a time series, but the x-axis is not comprised of points in time, and does not have an actual order



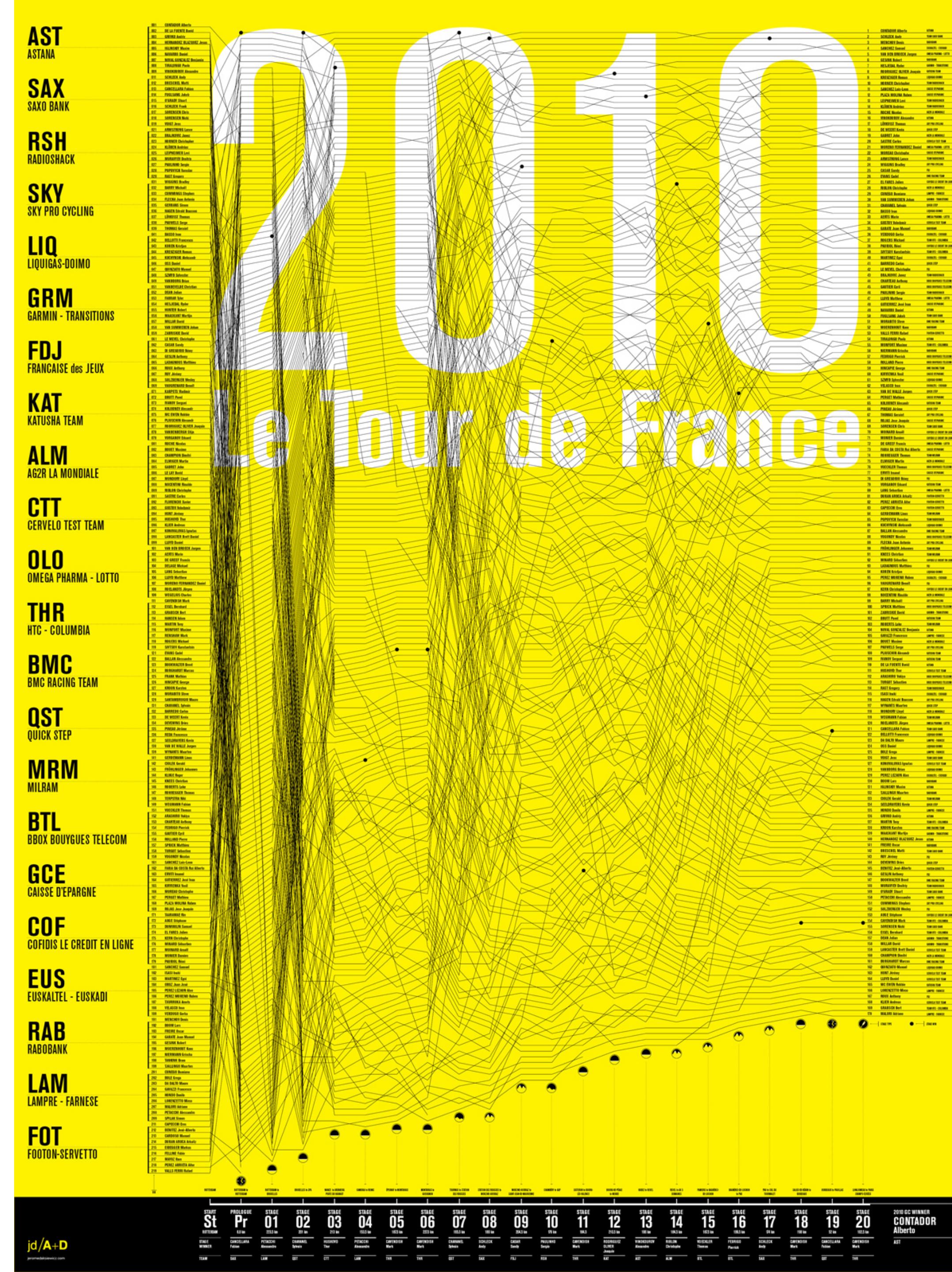
**Ungrouped, Snapshot, [ Comparison ]**

(ex.)



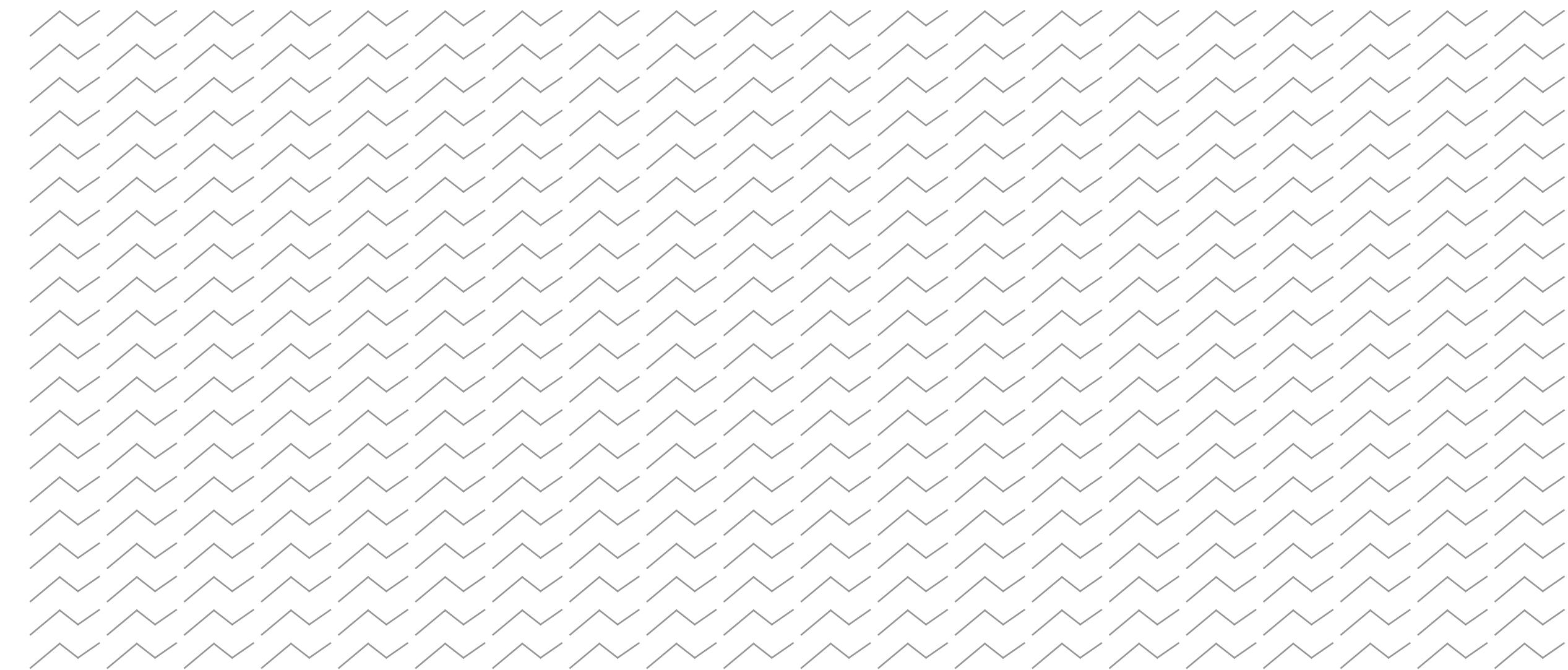
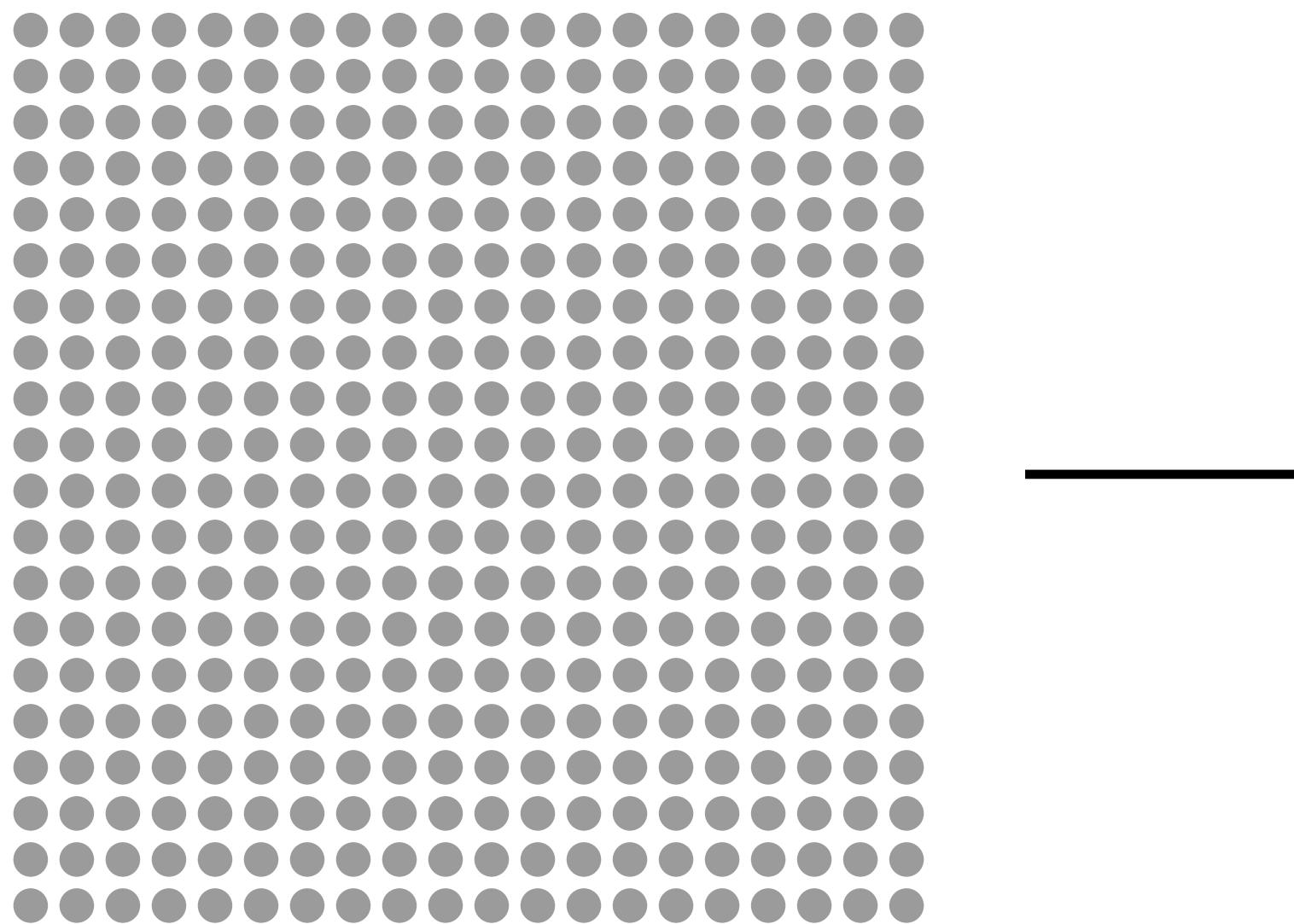
(ex.)

# Teams



# Race stages

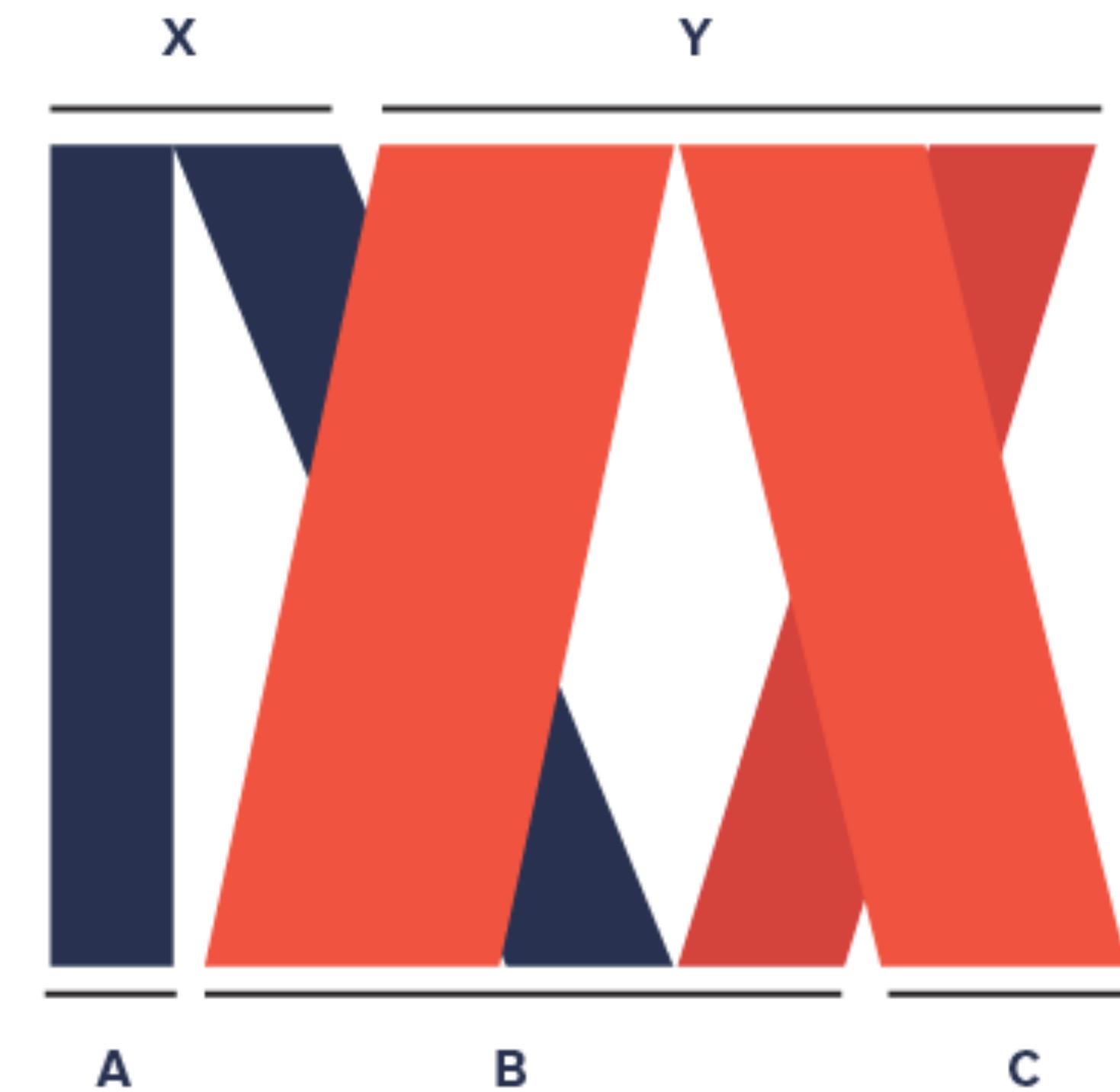
# 03 – Parallel coordinates



**Ungrouped, Snapshot**

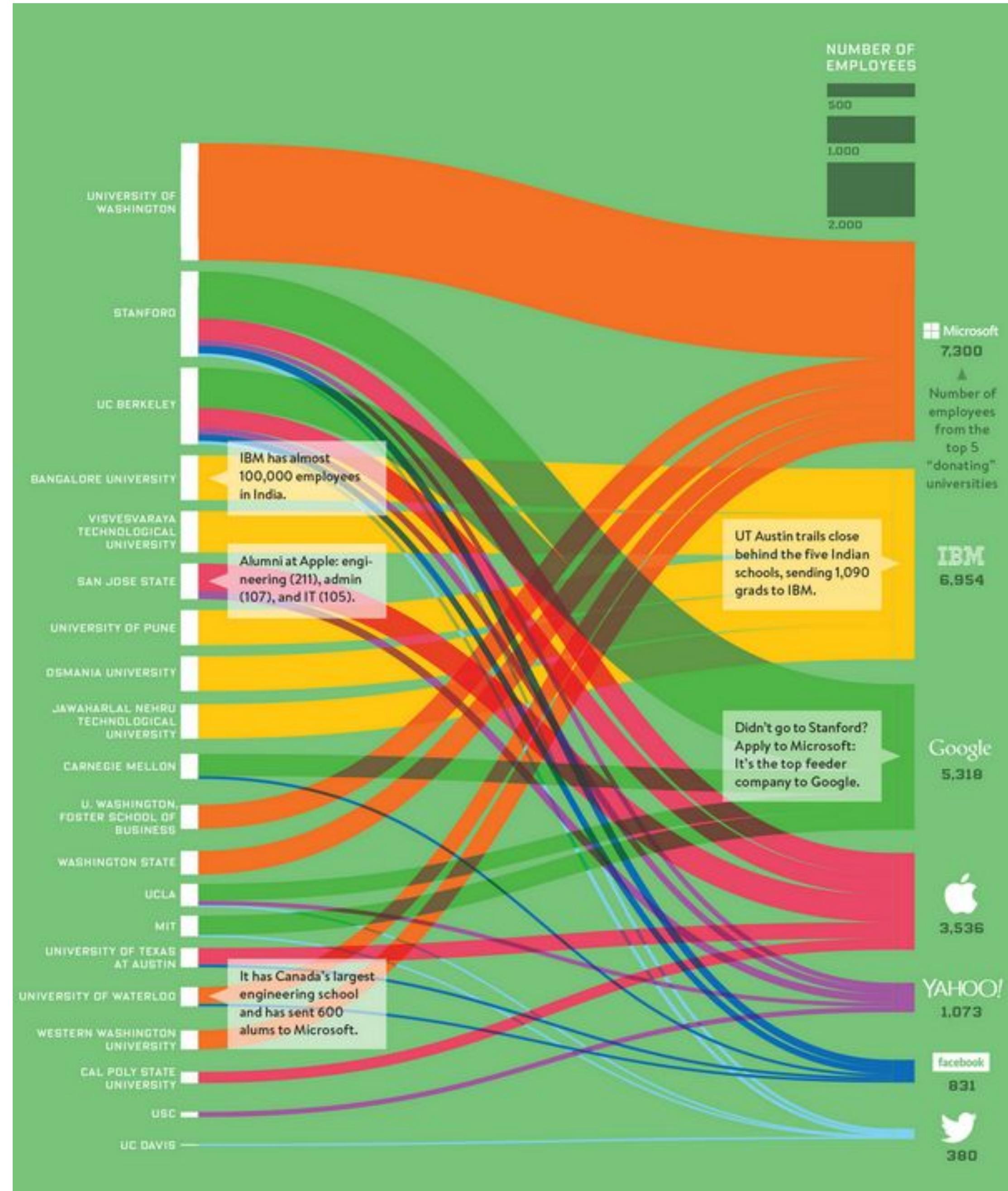
# 04 — Parallel sets

- Like parallel coordinates, but grouped
- Shows categorical data frequencies, and relations between categories

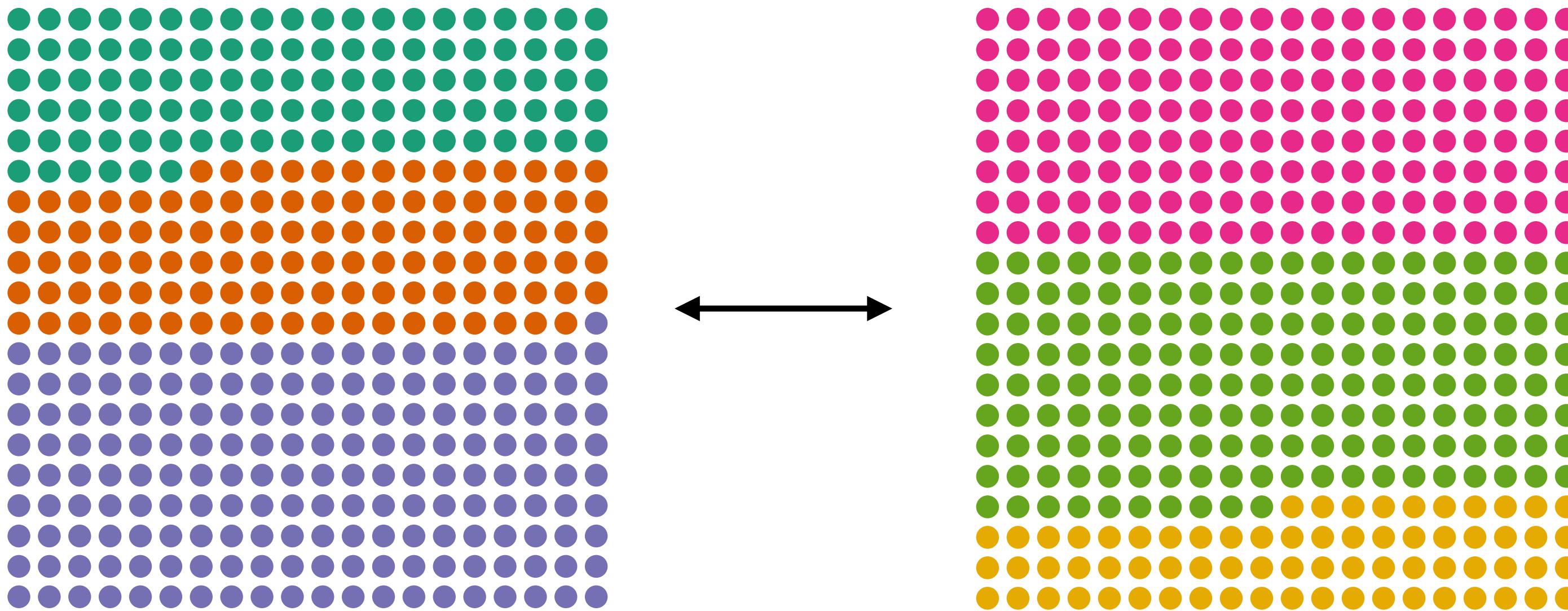


**Grouped, Snapshot, [ Comparison, Correlation, Distribution ]**

(ex.)



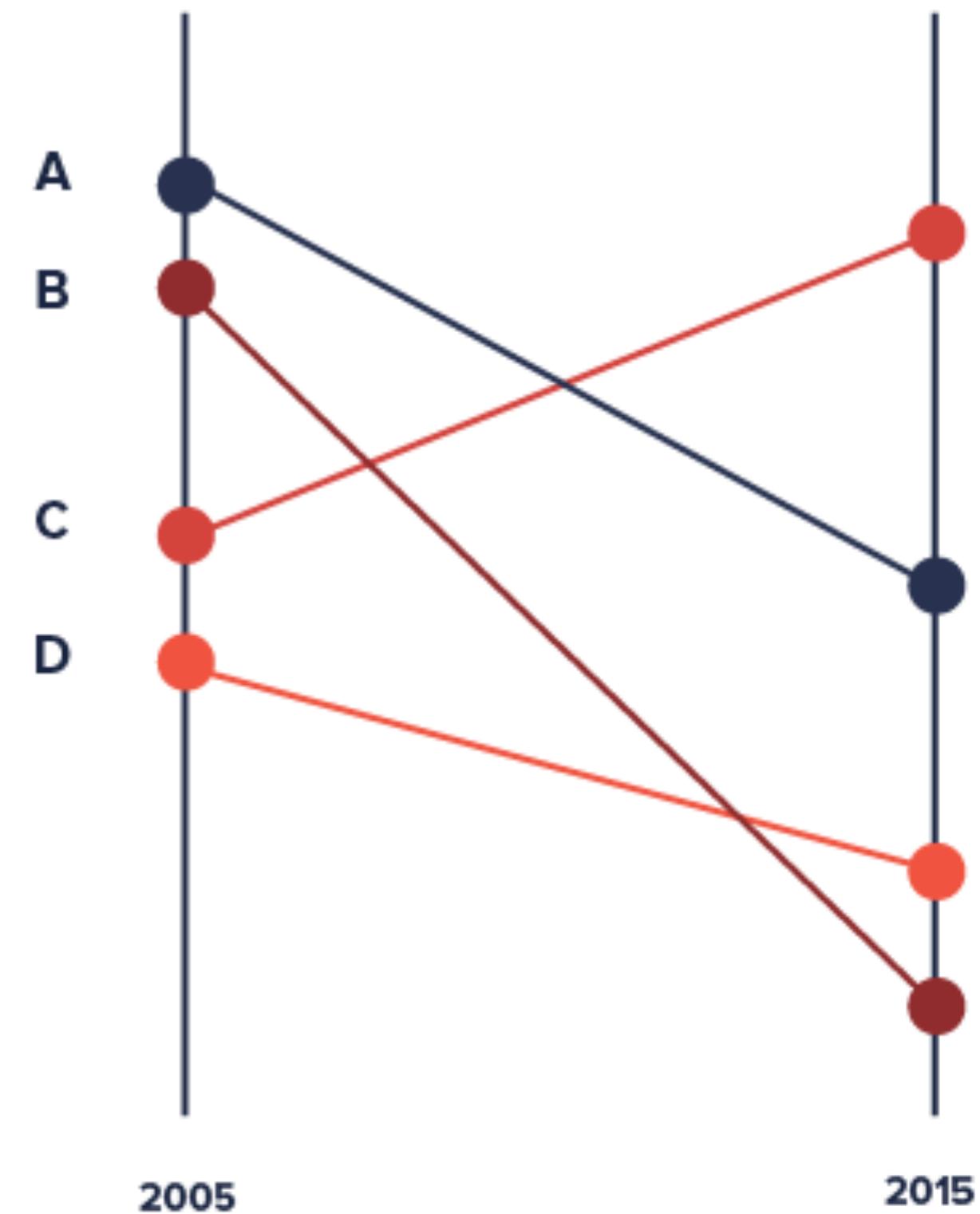
# 04 — Parallel sets



**Grouped, Snapshot**

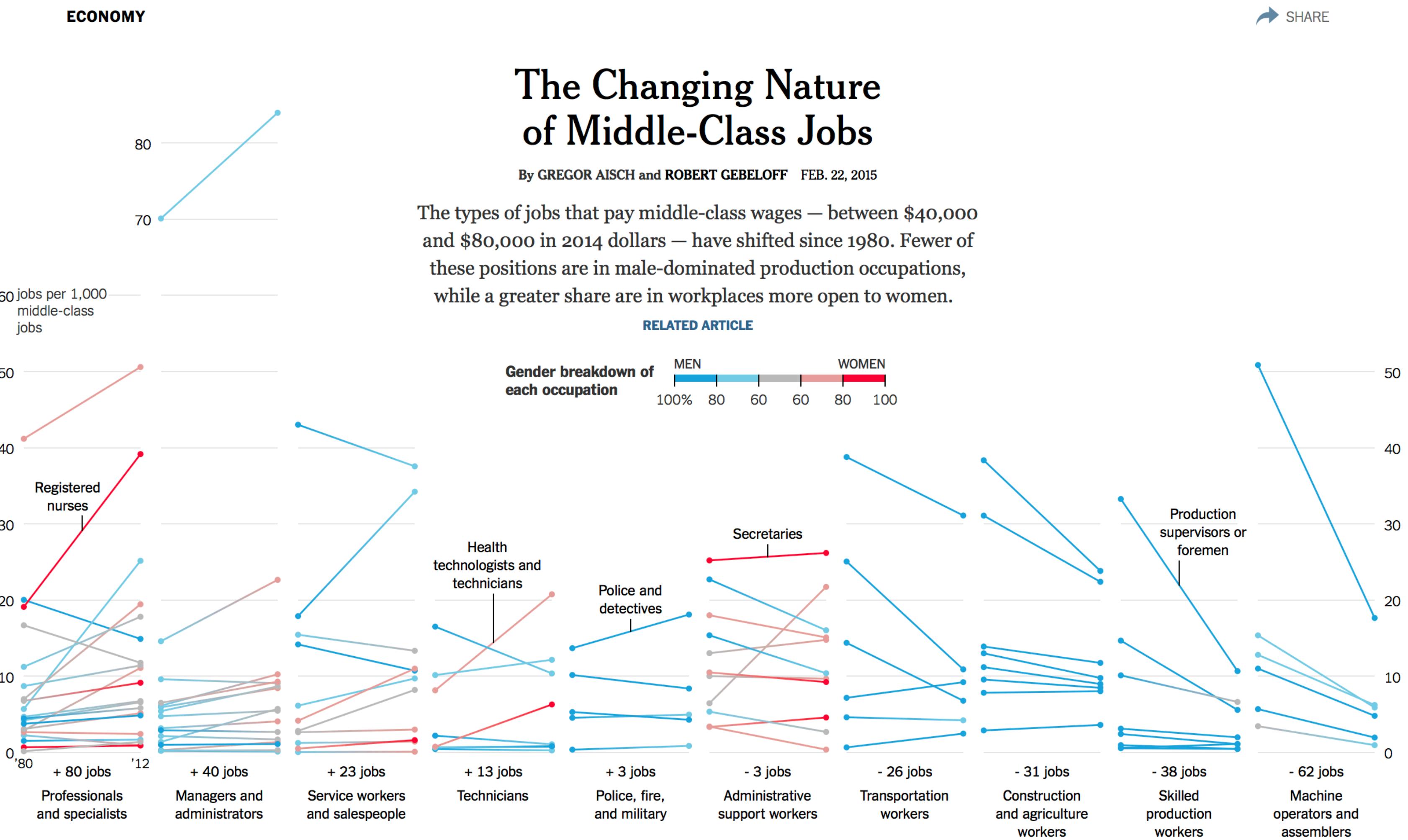
# 05 – Slopegraph

- Related to line charts, but show **exactly two points in time**
- Defined by Tufte
- Good for noticing deviations from a general trend



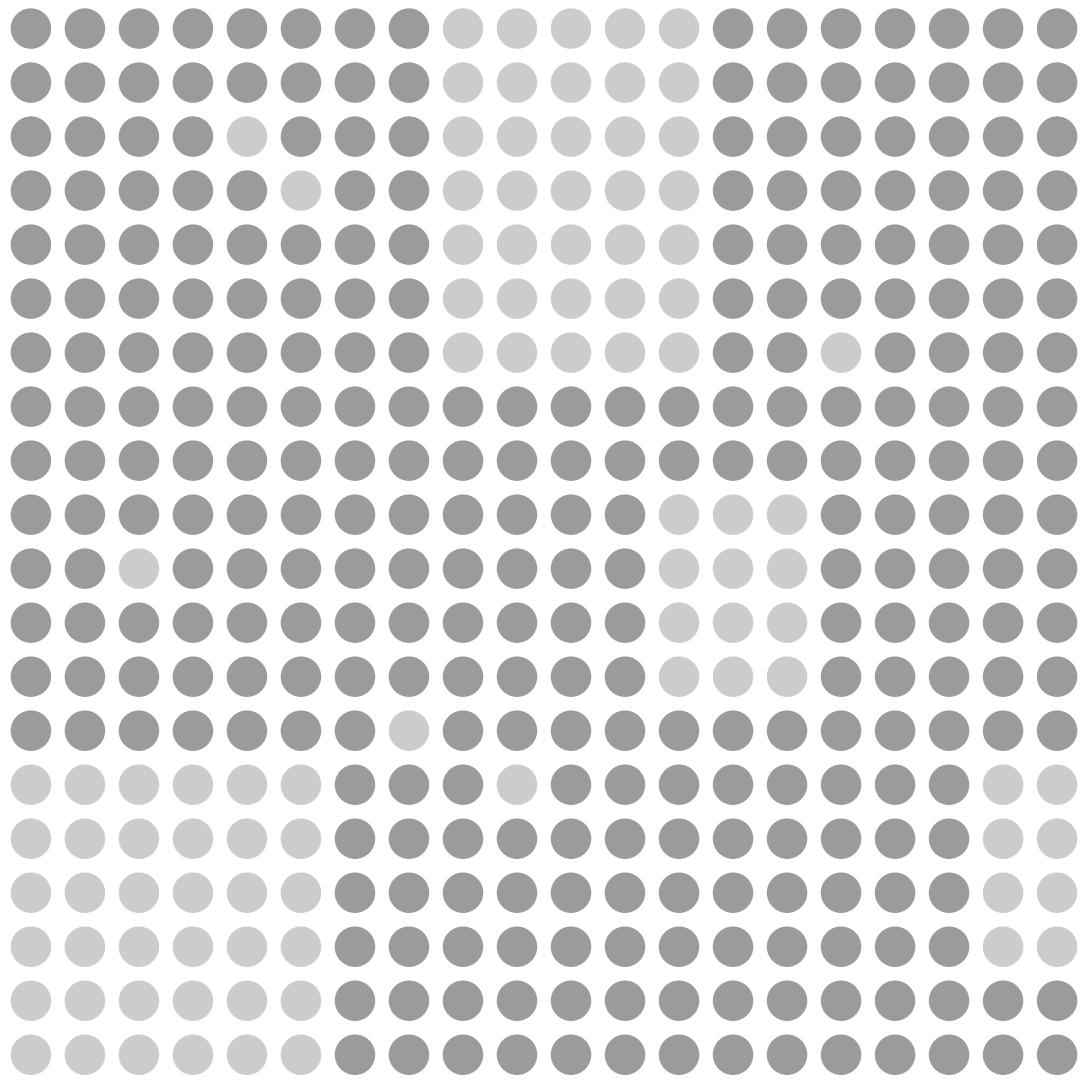
Ungrouped, Over time, [ Comparison, Trend ]

(ex.)

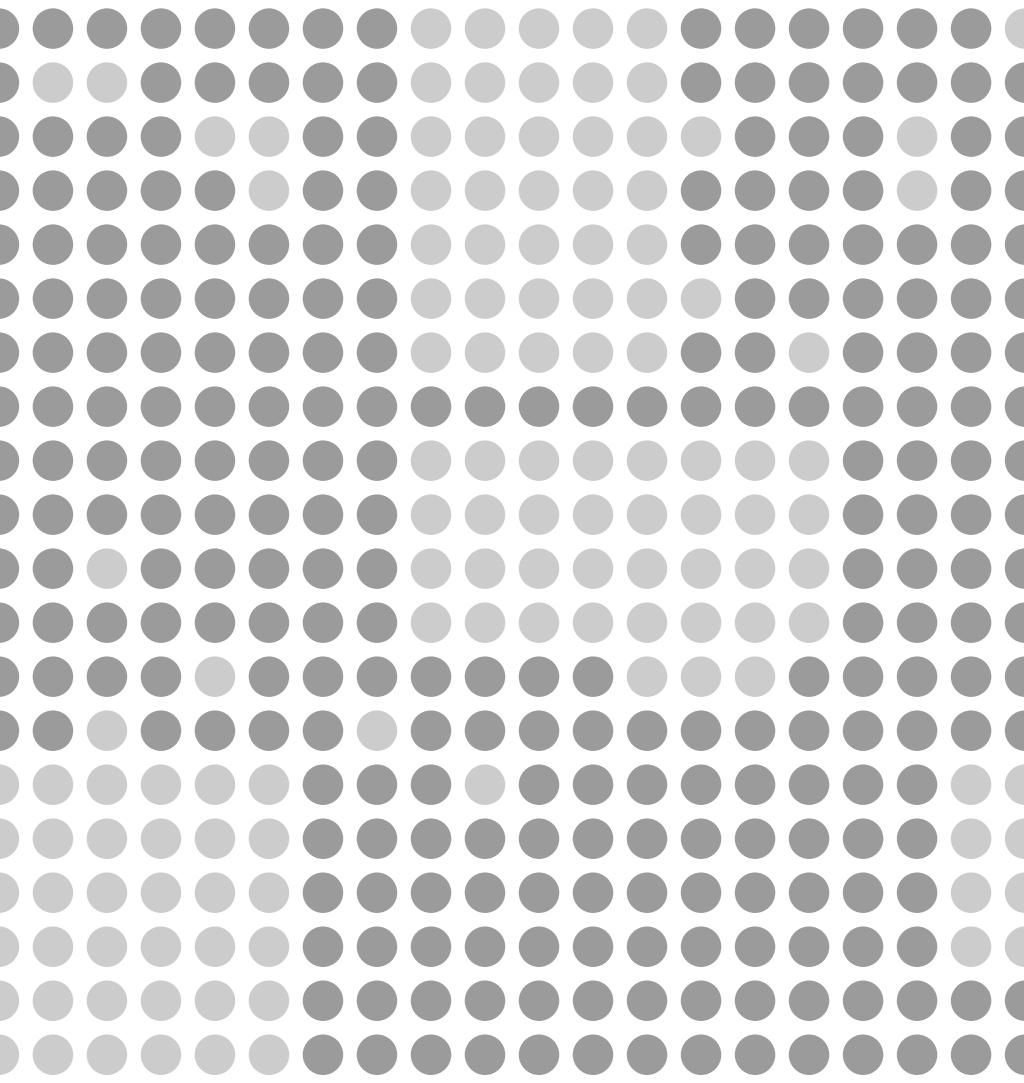


# 05 – Slopegraph

t1

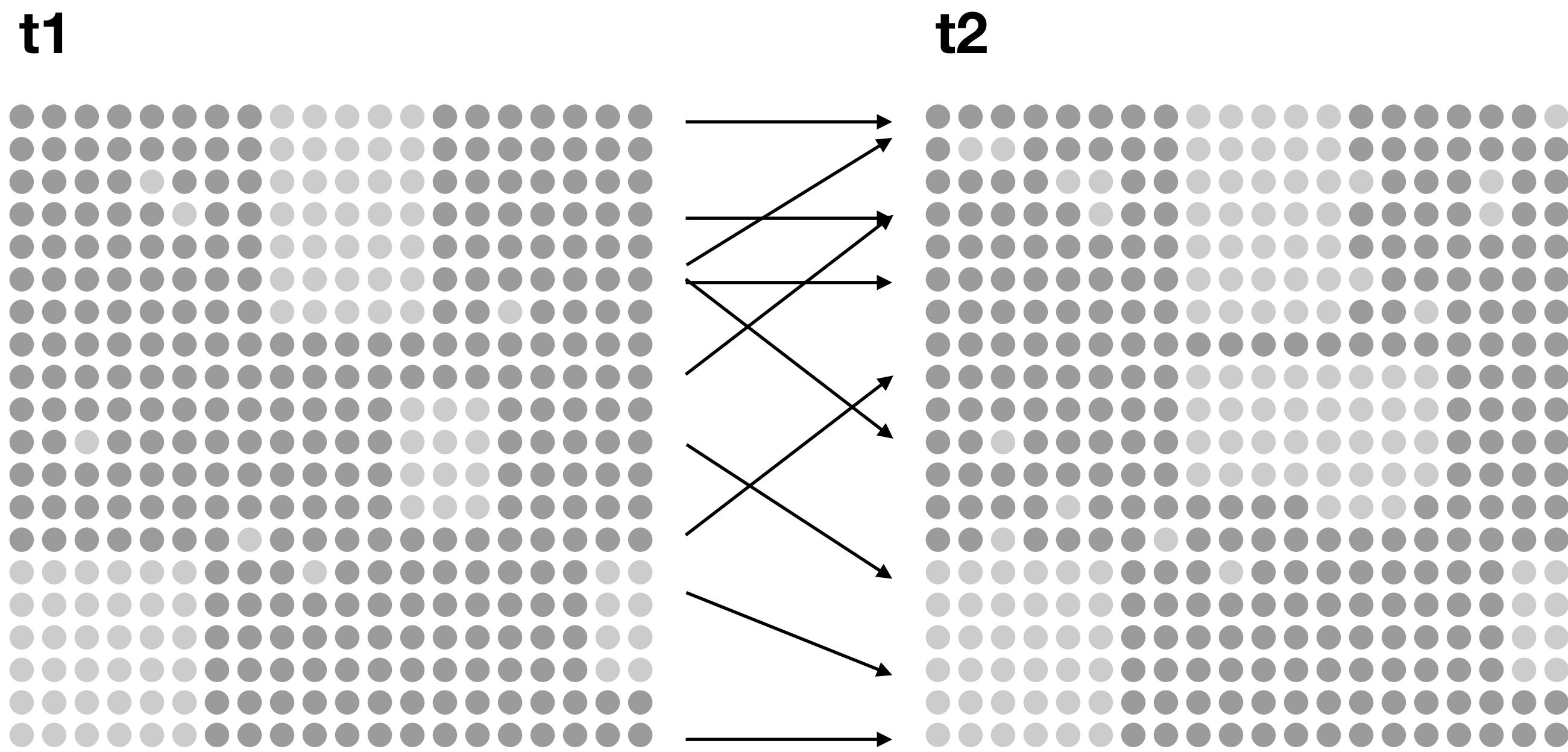


t2



**Ungrouped, Over time**

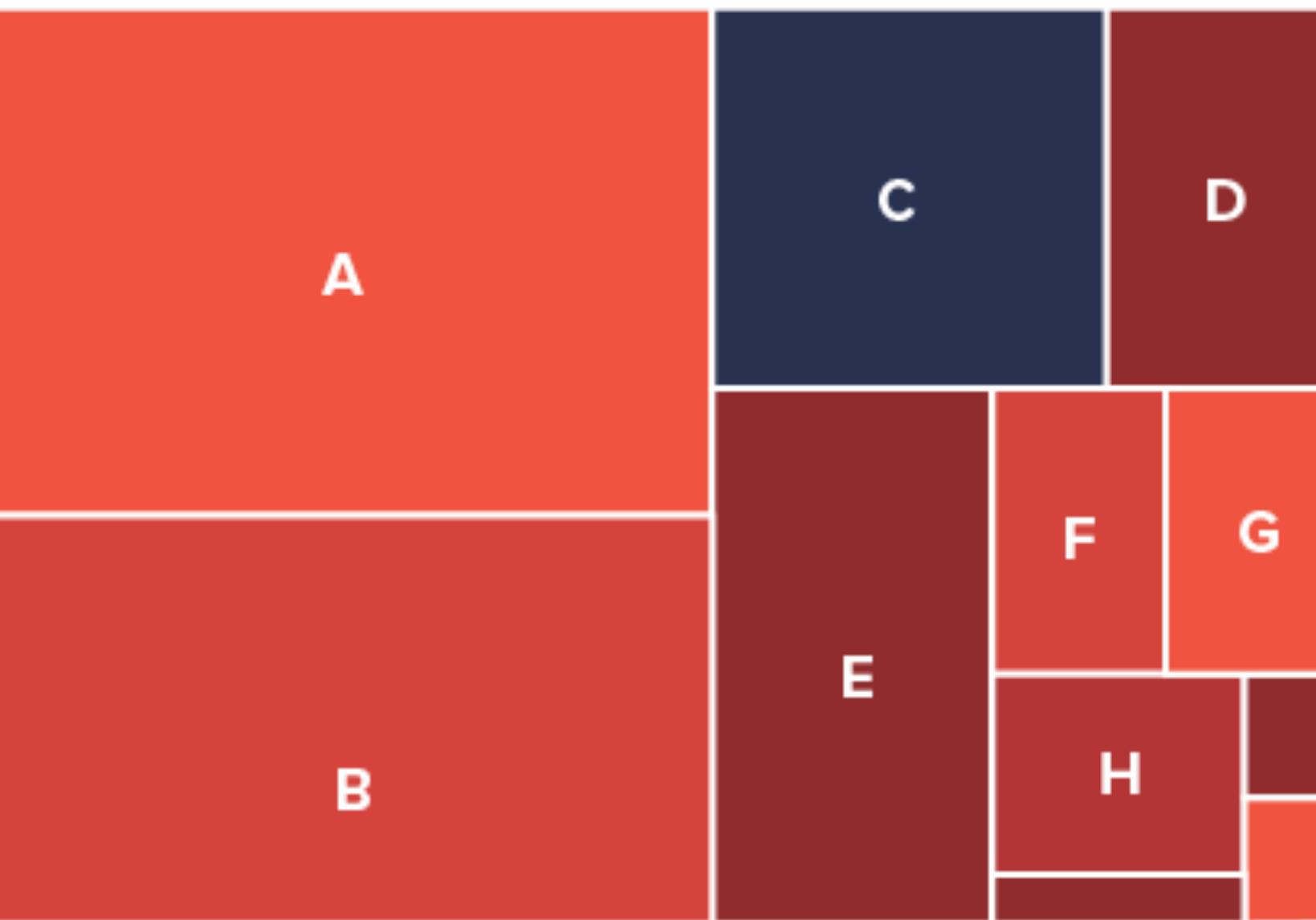
# 05 – Slopegraph



**Ungrouped, Over time**

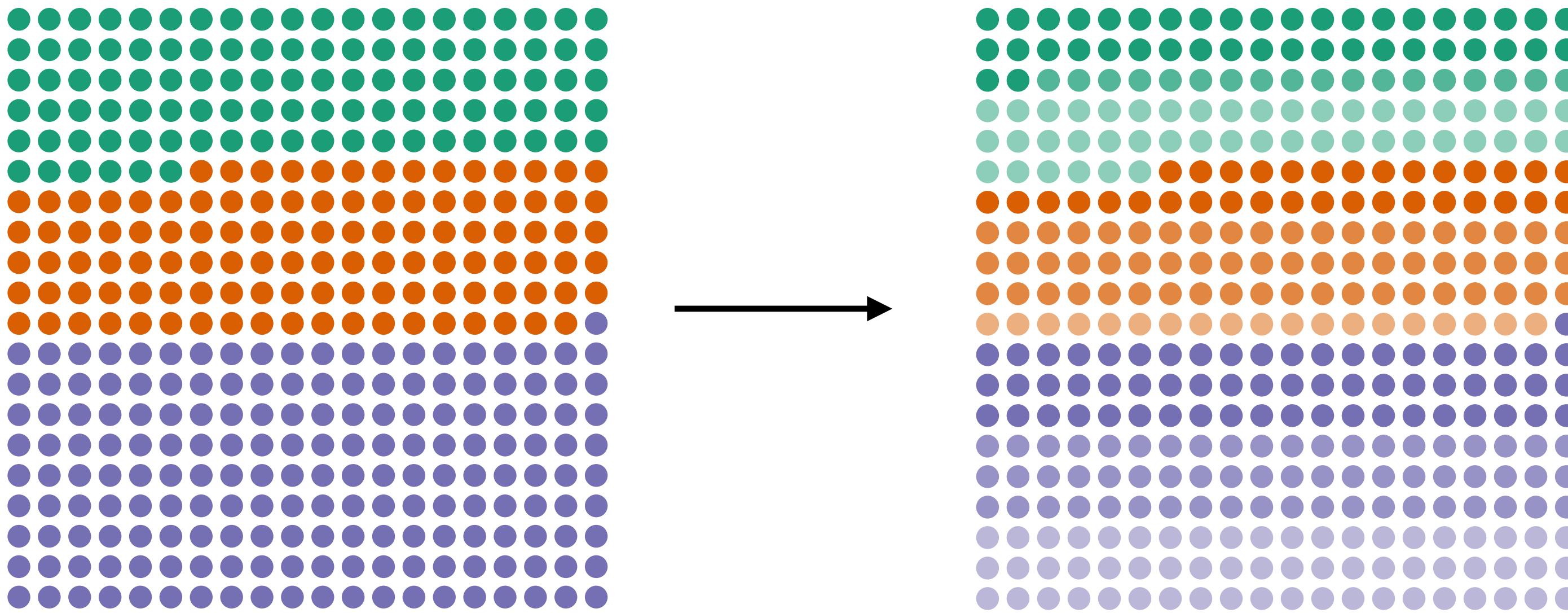
# 06 — Treemap

- Displays hierarchical data as a set of nested rectangles
- Each branch of a tree is given a rectangle, which is tiled with smaller rectangles



**Grouped, Snapshot, [ Comparison, Distribution ]**

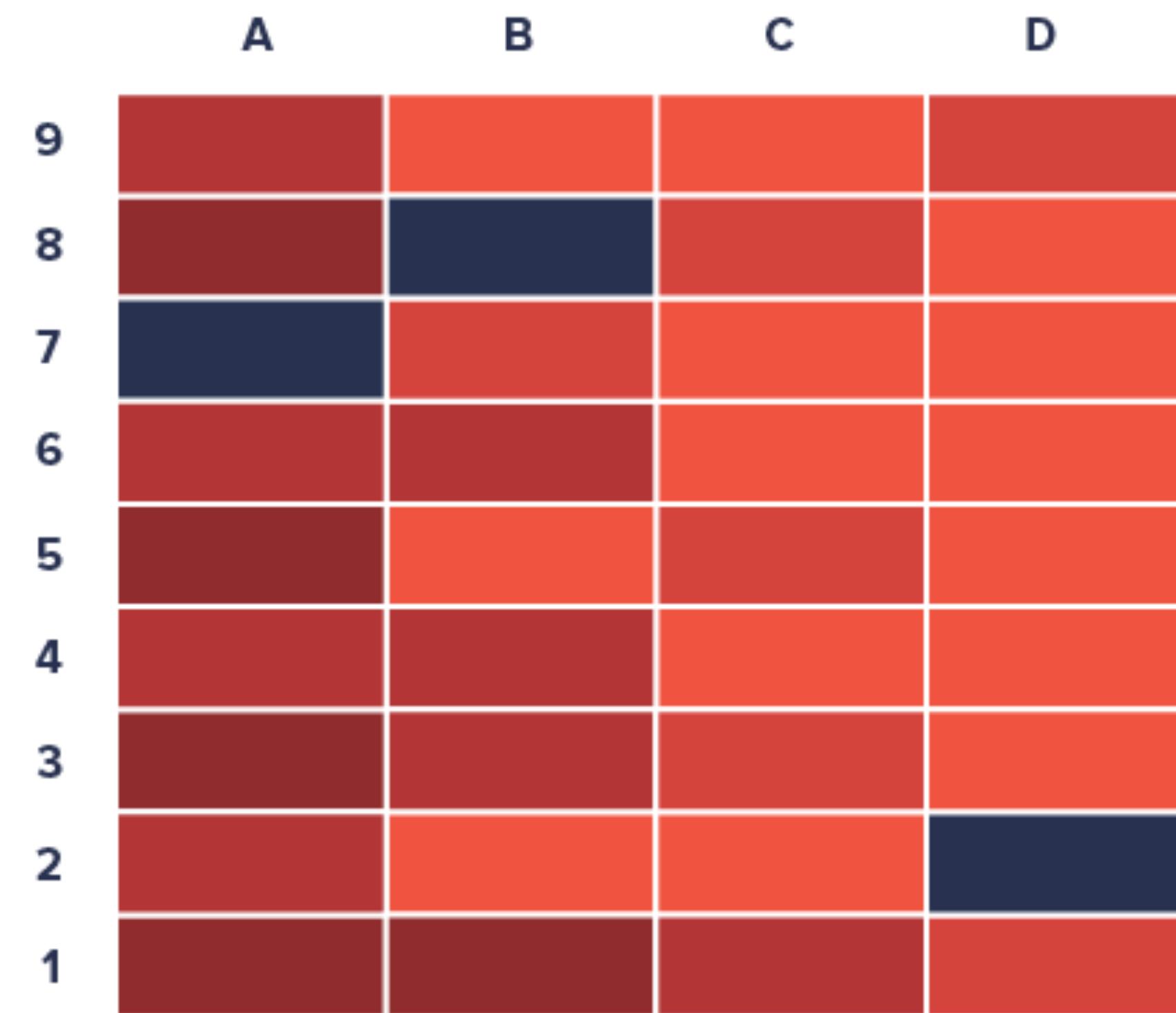
# 06 — Treemap



**Grouped, Snapshot**

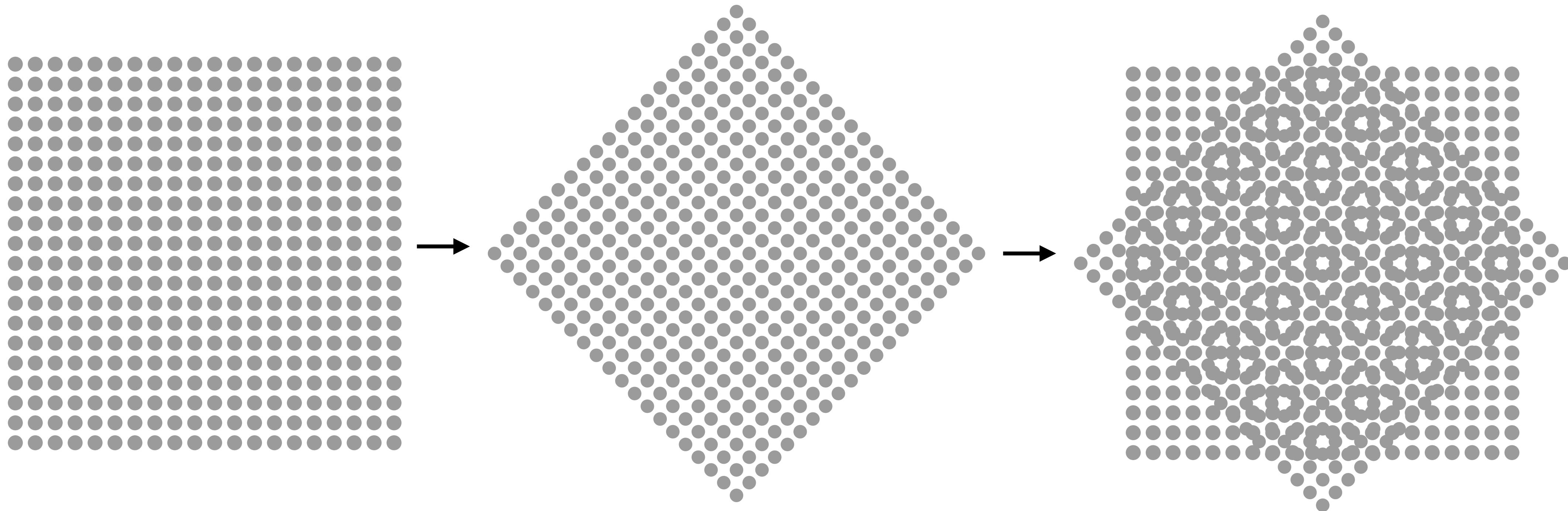
# 07 — Heat map

- Individual values determine the cell color in a matrix
- Useful for visualizing patterns across multiple variables



**Ungrouped, Snapshot, [ Comparison, Correlation, Distribution ]**

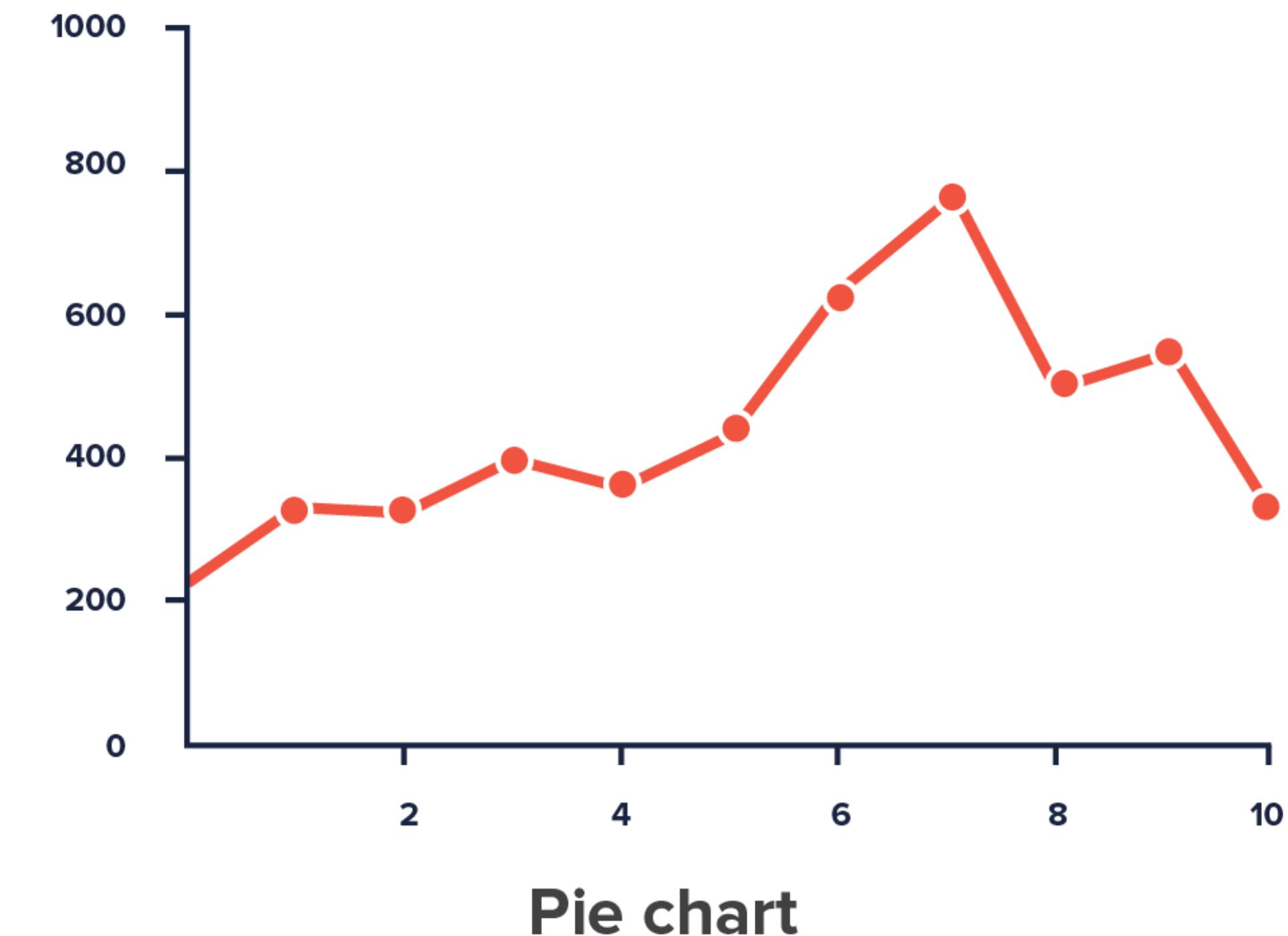
# 07 – Heat map



**Ungrouped, Snapshot**

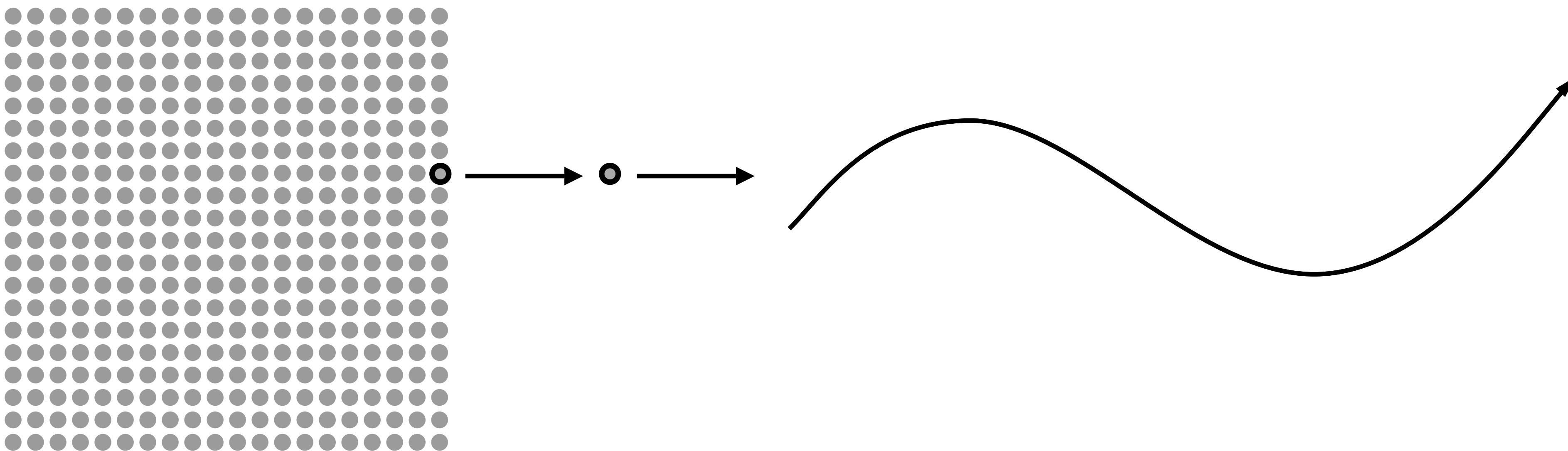
# 08 – Line chart

- Displays information as a series of data points connected by straight line segments
- Shows how something changes at equal intervals over time



**Ungrouped, Over time, [ Trend ]**

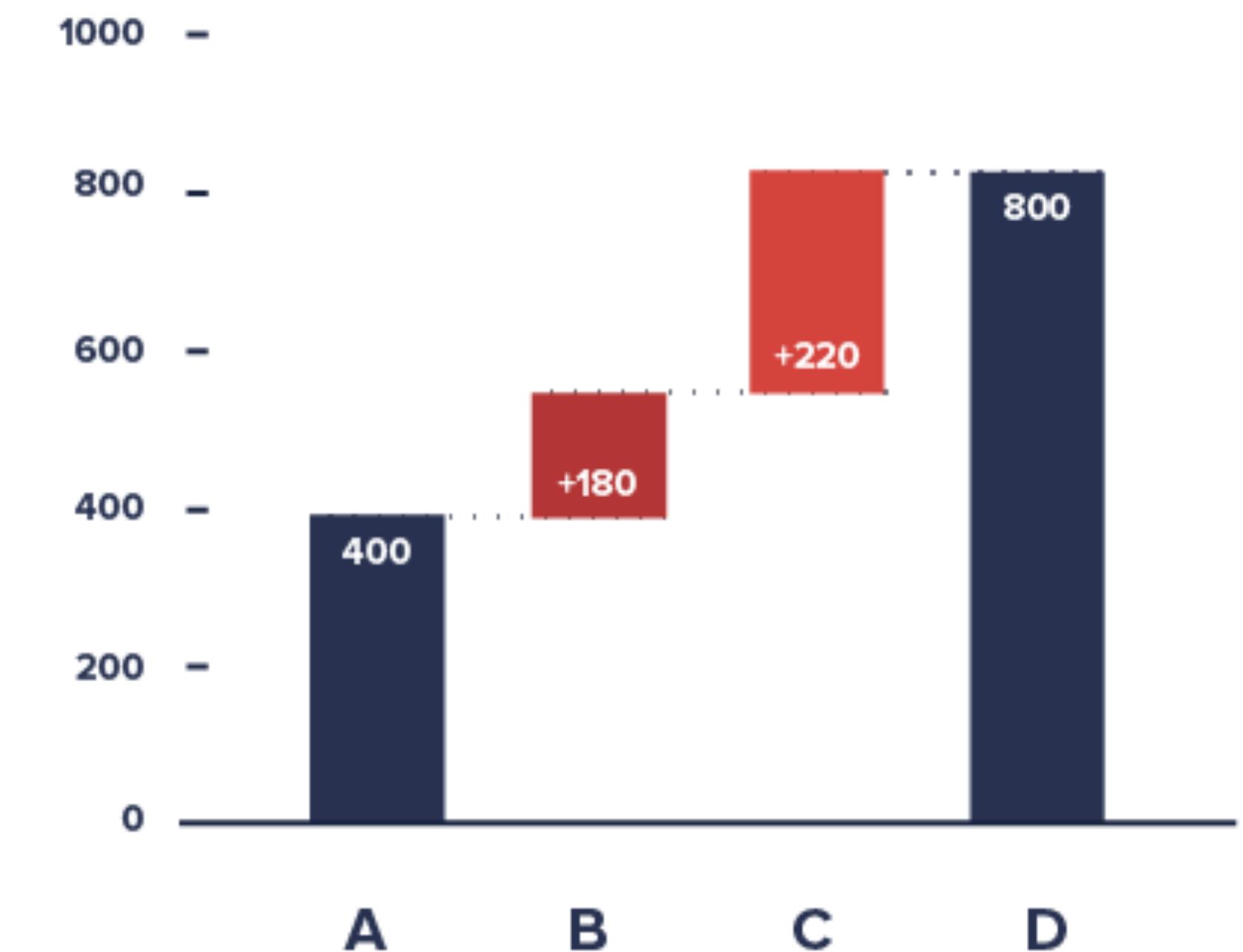
# 08 – Line chart



**Ungrouped, Over time**

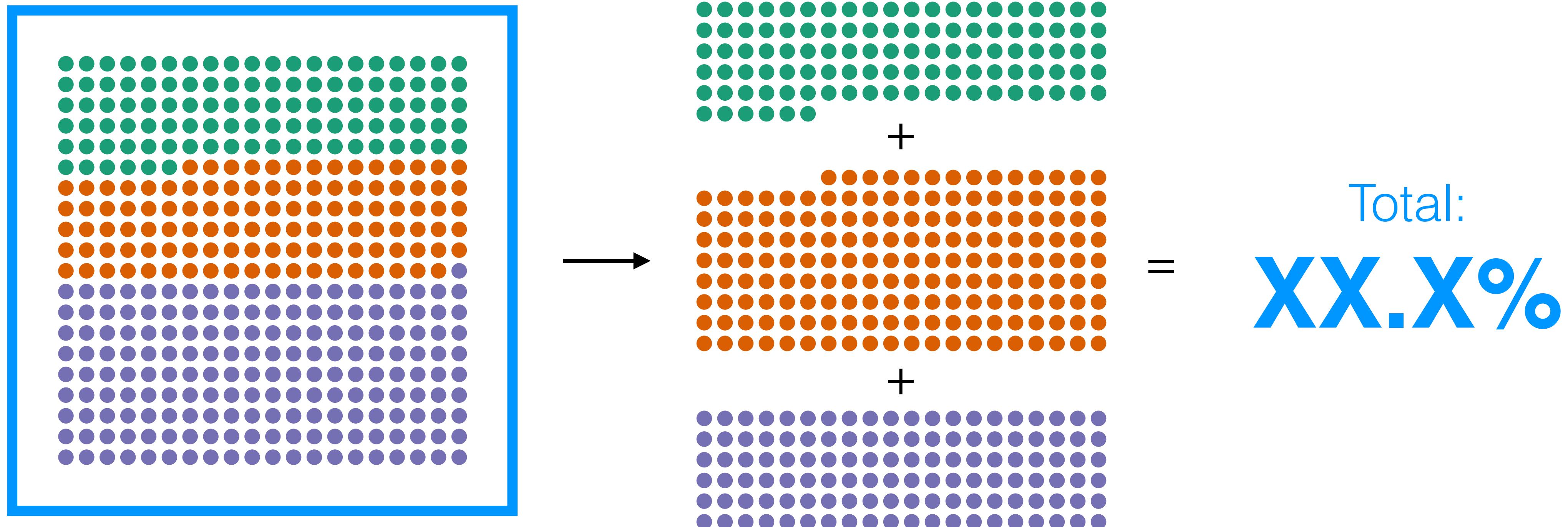
# 09 — Waterfall chart

- Helps make visible the **cumulative effect** of sequential positive and negative values
- Used for understand how an initial value is affected by intermediate positive or negative values



**Grouped, Snapshot, [ Comparison, Distribution ]**

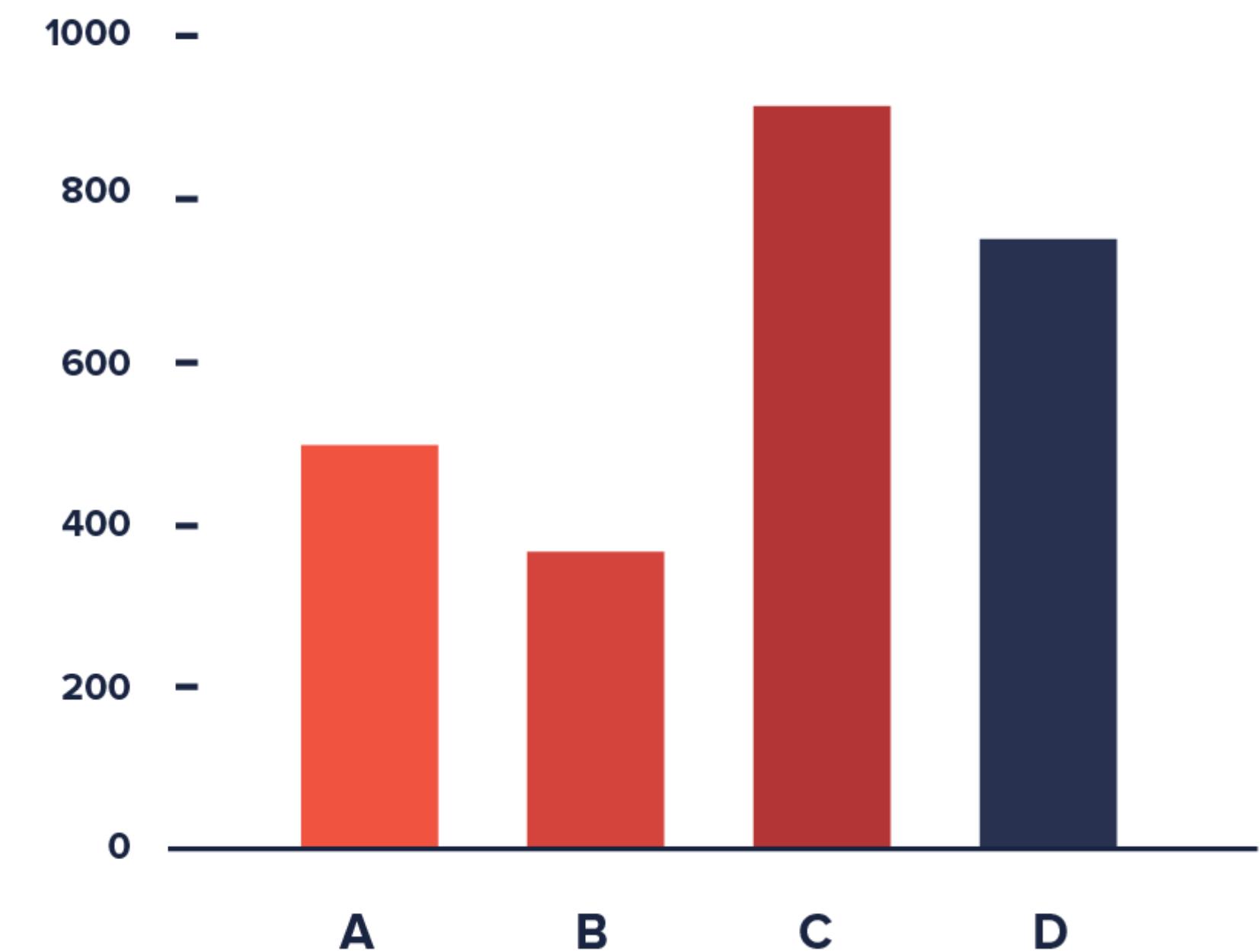
# 09 – Waterfall chart



**Grouped, Snapshot**

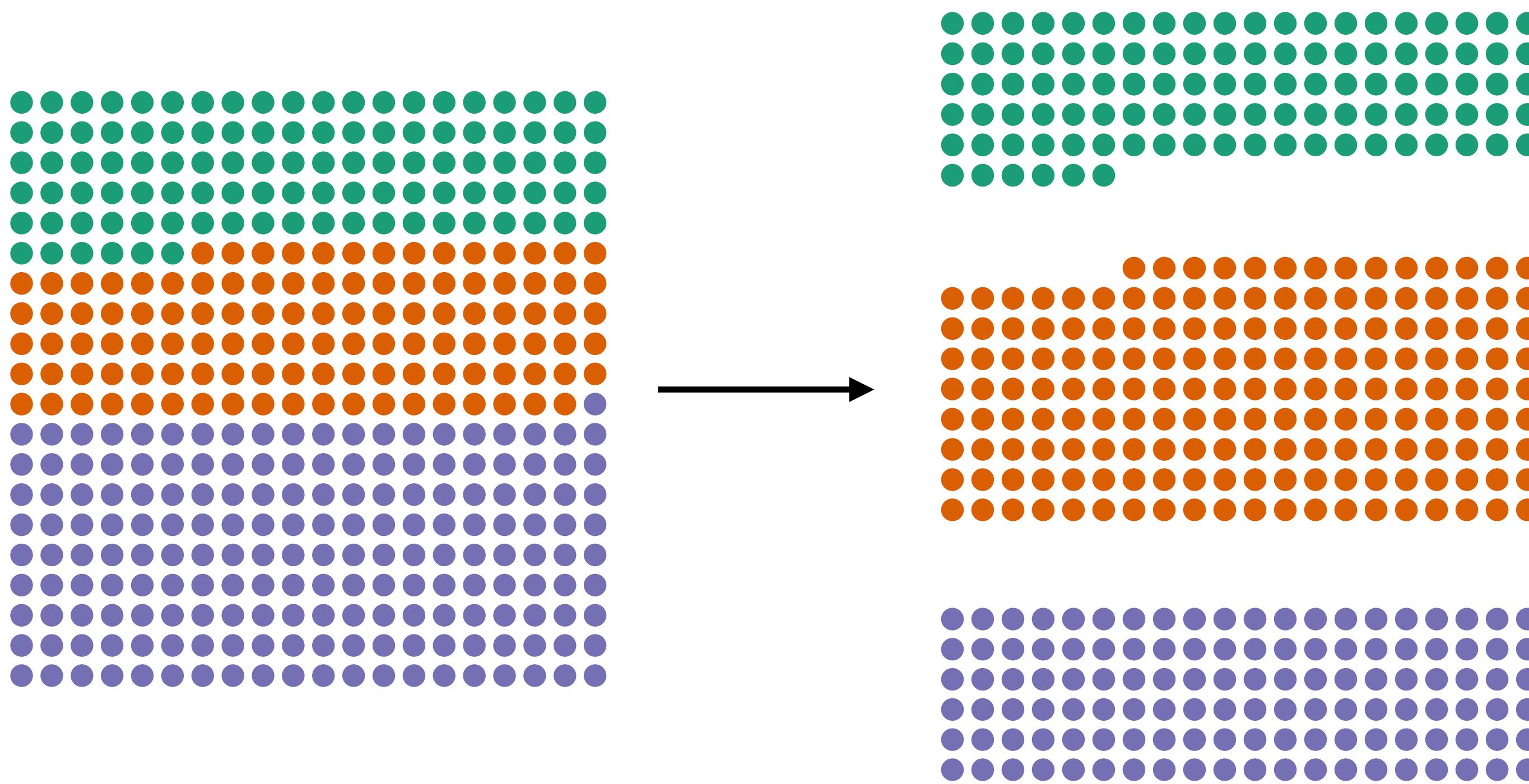
# 10 — Bar chart

- Lengths proportionate to the values the bars represent
- One axis shows specific categories, the other represents a discrete value



**Grouped, Snapshot, [ Comparison, Trend ]**

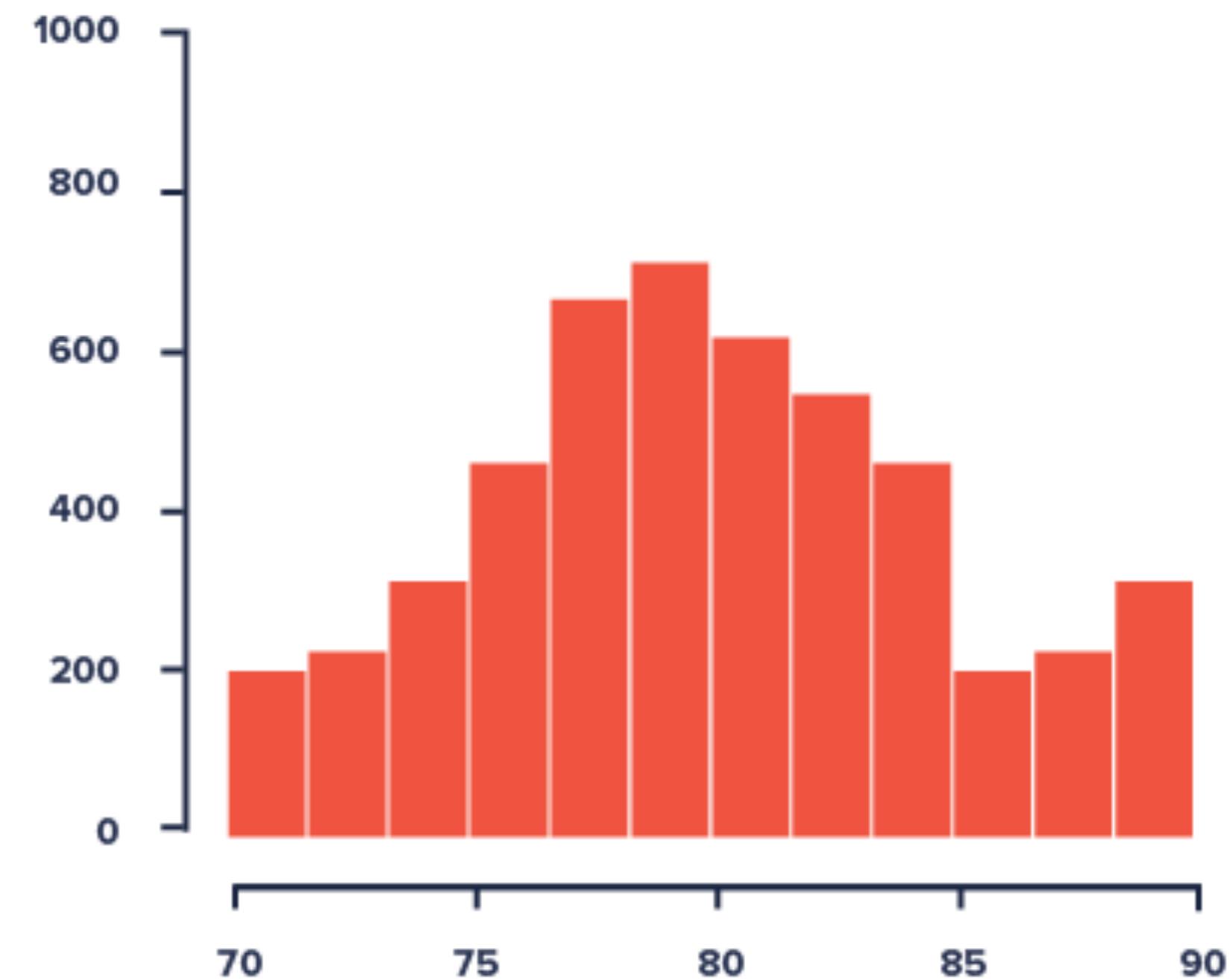
# 10 — Bar chart



**Grouped, Snapshot**

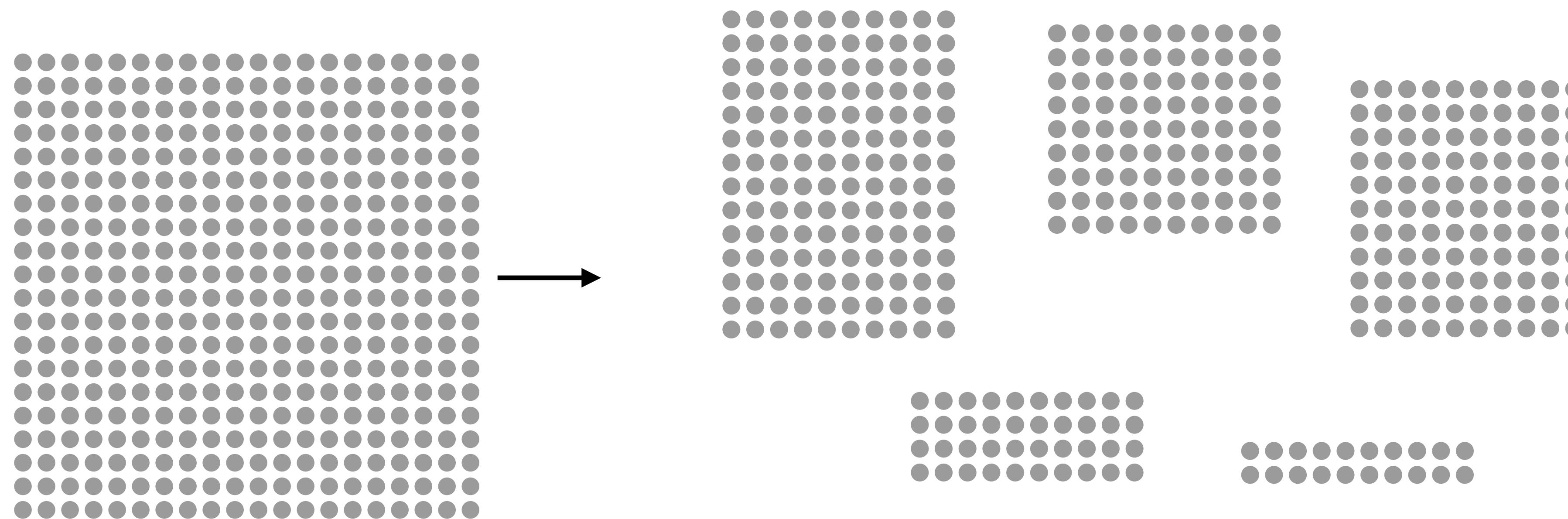
# 11 — Histogram

- Groups numeric data into **bins**
- Used to depict the distribution of a dataset: how often values fall into ranges



**Grouped, Snapshot, [ Comparison, Distribution ]**

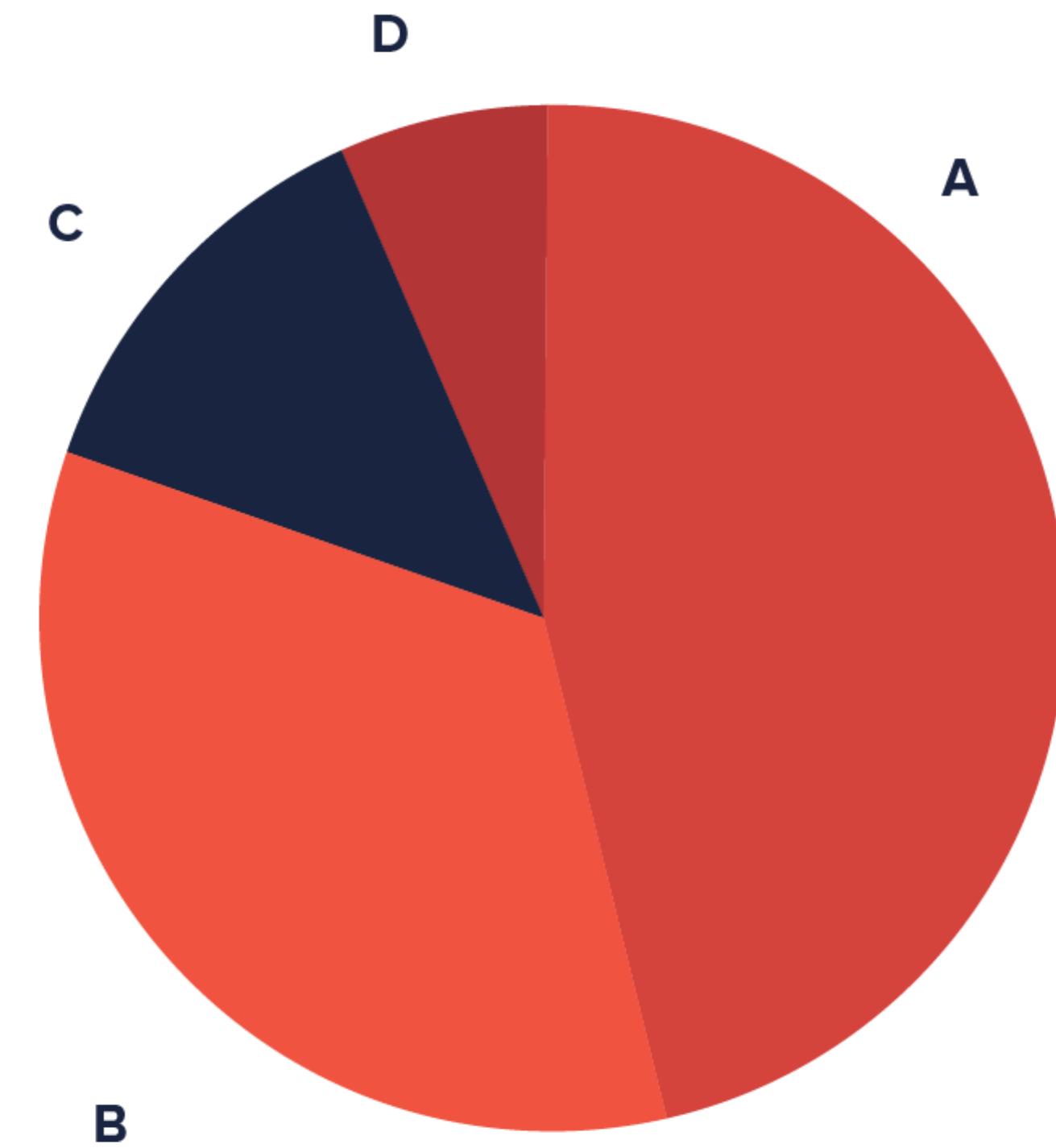
# 11 — Histogram



**Grouped, Snapshot**

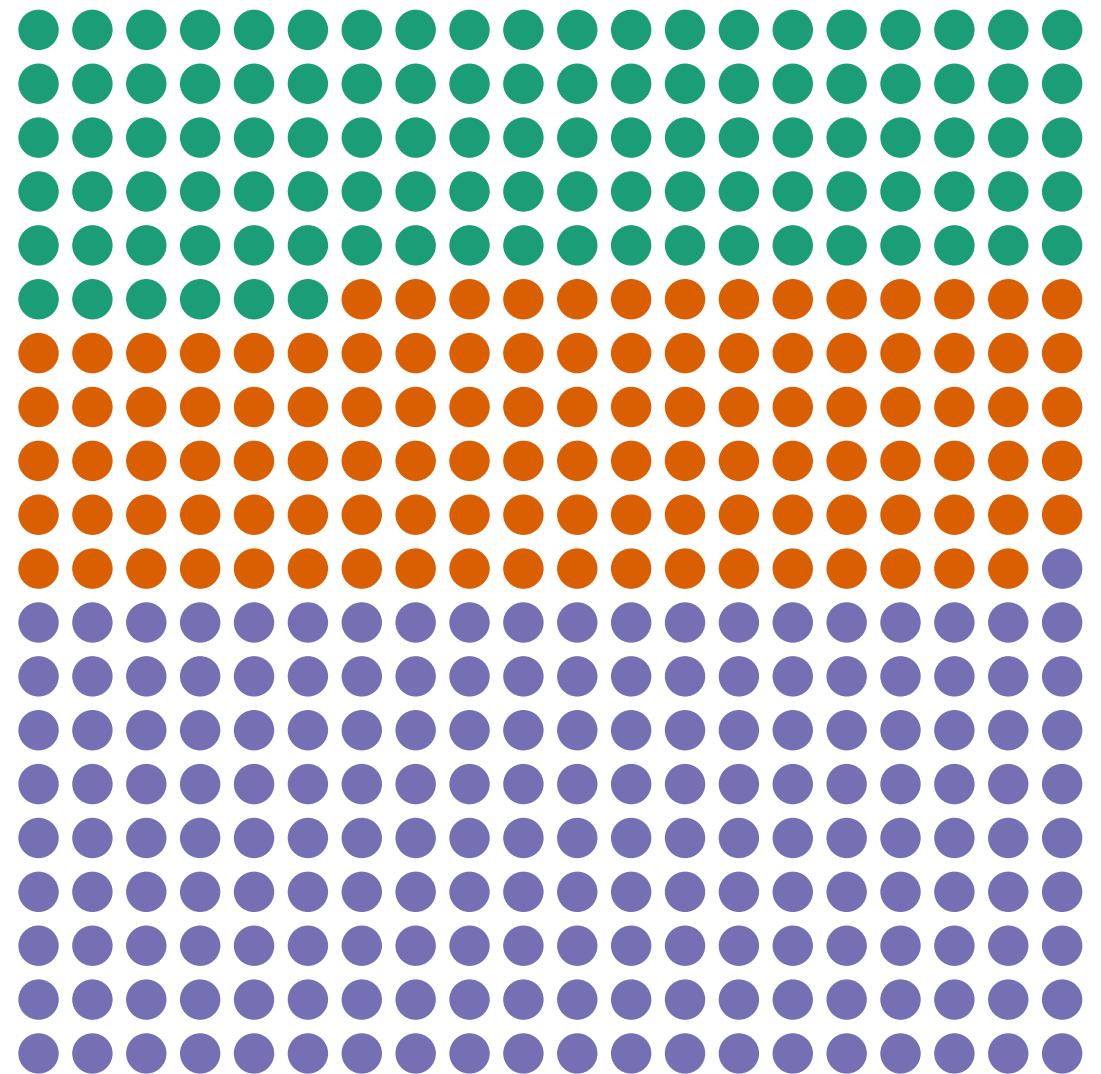
# 12 — Pie chart

- Divided into sectors, illustrating numerical proportion
- Each wedge is proportional to the quantity it represents



**Grouped, Snapshot, [ Comparison ]**

# 12 – Pie chart



**Grouped, Snapshot**

# Storytelling with data

Effective storytelling leverages **grouping**,  
**temporality**, and **functions** of charting methods  
to inform the viewer's perception of a narrative.

# 5 Steps

1. **Figure out what your story is.**
2. Write it out in sentences. Make those sentences flow in a **narrative**.
3. Boil your sentences down into **semantic relationships**.
4. Boil your sentences down into grouping, temporality, and functions it implies.
5. Choose the applicable way to **display** the data you have.

*2. Write it out in sentences*

“This team had an outstanding season.”

### *3. Determine semantic relationships*

“This team had an outstanding season.”

= This thing is way better than some other things like it.

## *4. Determine grouping, temporality, and functions*

“This team had an outstanding season.”

Grouping?

## *4. Determine grouping, temporality, and functions*

“**This team** had an outstanding season.”

**Ungrouped**

## *4. Determine grouping, temporality, and functions*

“This team had an outstanding season.”

**Ungrouped**, Temporality?

## *4. Determine grouping, temporality, and functions*

“This team had an outstanding **season**.”

**Ungrouped**, ( **Over time / Snapshot** )

## *4. Determine grouping, temporality, and functions*

“This team had an outstanding season.”

**Ungrouped**, ( **Over time / Snapshot** ), Functions?

## *4. Determine grouping, temporality, and functions*

“This team had an **outstanding** season.”

**Ungrouped**, ( **Over time / Snapshot** ), [ **Comparison, (Correlation, Trend)** ]

2. Write it out in sentences

“Revenue has increased significantly for these types of organizations since last year, but not these types of organizations.”

### *3. Determine semantic relationships*

“Revenue has increased significantly for these types of organizations since last year, but not these types of organizations.”

= These types of things got bigger faster than these types of things.

#### *4. Determine grouping, temporality, and functions*

“Revenue has increased significantly for these types of organizations since last year, but not these types of organizations.”

Grouping?

#### *4. Determine grouping, temporality, and functions*

“Revenue has increased significantly for **these types** of organizations since last year, but not **these types** of organizations.”

**Grouped**

#### *4. Determine grouping, temporality, and functions*

“Revenue has increased significantly for these types of organizations **since last year**, but not these types of organizations.”

**Grouped**, Temporality?

#### *4. Determine grouping, temporality, and functions*

“Revenue has increased significantly for these types of organizations since last year, but not these types of organizations.”

**Grouped, ( Over time / Snapshot )**

#### *4. Determine grouping, temporality, and functions*

“Revenue has increased significantly for these types of organizations since last year, but not these types of organizations.”

**Grouped**, ( **Over time** / **Snapshot** ), Functions?

#### *4. Determine grouping, temporality, and functions*

“Revenue has increased significantly for these types of organizations  
**since last year, but not these types of organizations.**”

**Grouped**, ( **Over time / Snapshot** ), [ **Comparison, Correlation, Trend** ]

*2. Write it out in sentences*

“This runner just barely finished first.”

### *3. Determine semantic relationships*

“This runner just barely finished first.”

= This thing was slightly faster than all the other things.

## *4. Determine grouping, temporality, and functions*

“This runner just barely finished first.”

Grouping?

## *4. Determine grouping, temporality, and functions*

“**This runner** just barely finished first.”

**Ungrouped**

## *4. Determine grouping, temporality, and functions*

“This runner just barely finished first.”

**Ungrouped**, Temporality?

## *4. Determine grouping, temporality, and functions*

“This runner just barely **finished first**.”

**Grouped**, ( **Over time / Snapshot** )

## *4. Determine grouping, temporality, and functions*

“This runner just barely finished first.”

**Ungrouped**, ( **Over time / Snapshot** ), Functions?

## *4. Determine grouping, temporality, and functions*

“This runner **just barely** finished first.”

**Ungrouped**, ( **Over time / Snapshot** ), [ [Comparison](#) ]

# Perception in practice

→ **Magnitude Channels: Ordered Attributes**

Position on common scale



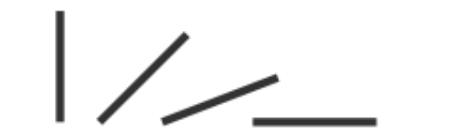
Position on unaligned scale



Length (1D size)



Tilt/angle



Area (2D size)



Depth (3D position)



Color luminance



Color saturation



Curvature



Volume (3D size)



→ **Identity Channels: Categorical Attributes**

Spatial region



Color hue



Motion



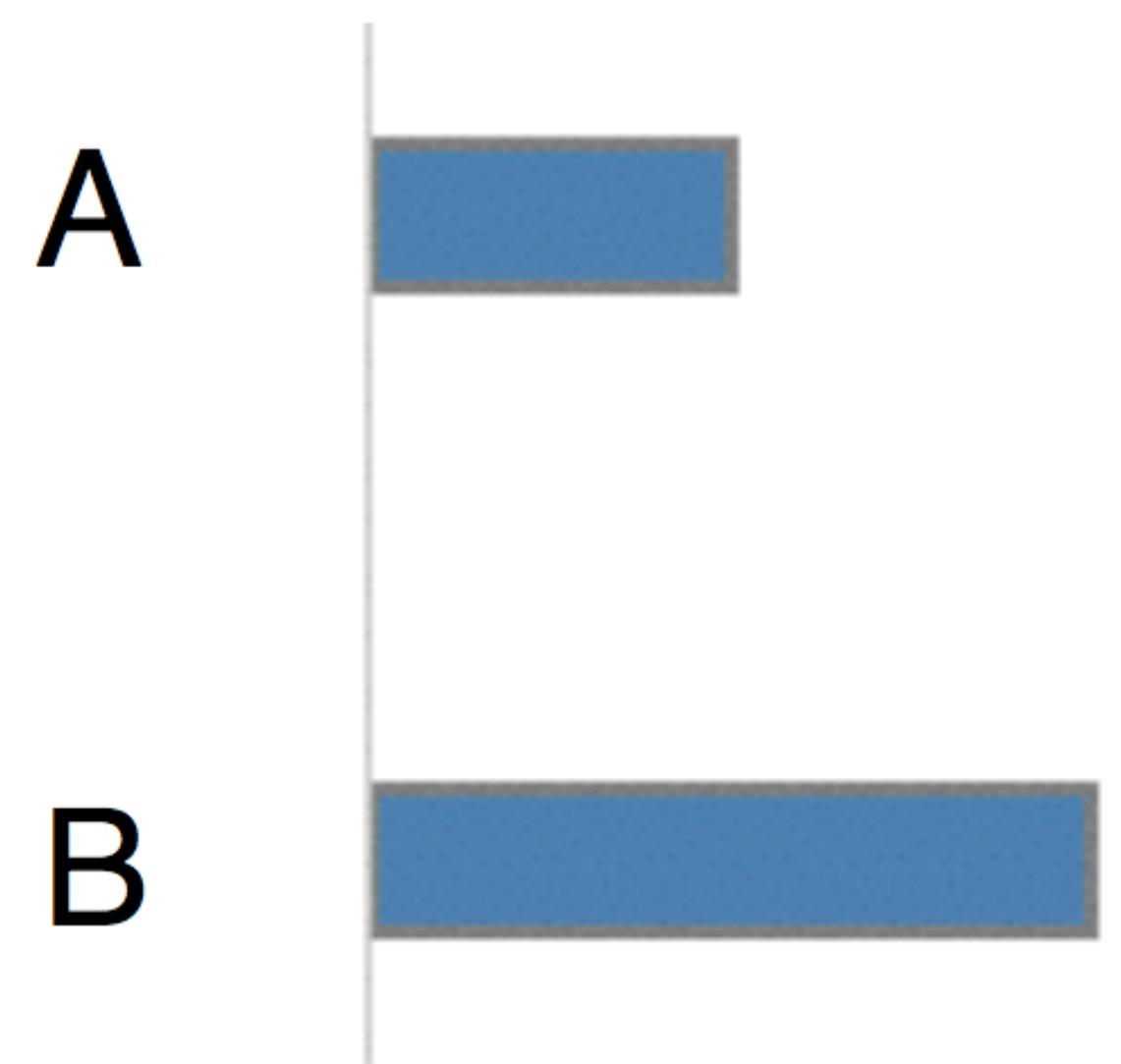
Shape



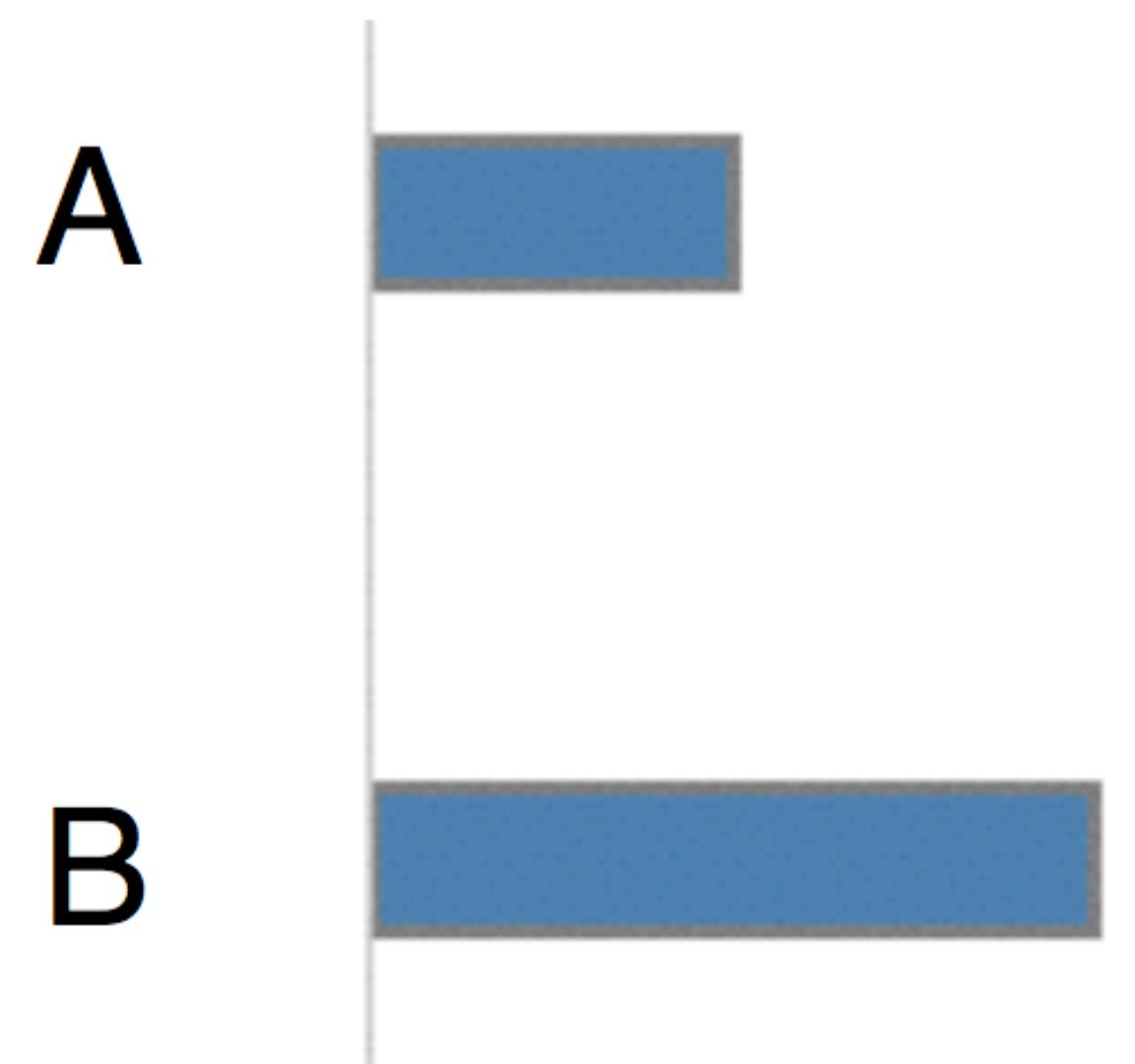
▲ Most  
— Effectiveness  
▼ Least

[ Same ] [ Same ]

# Test — How much longer?

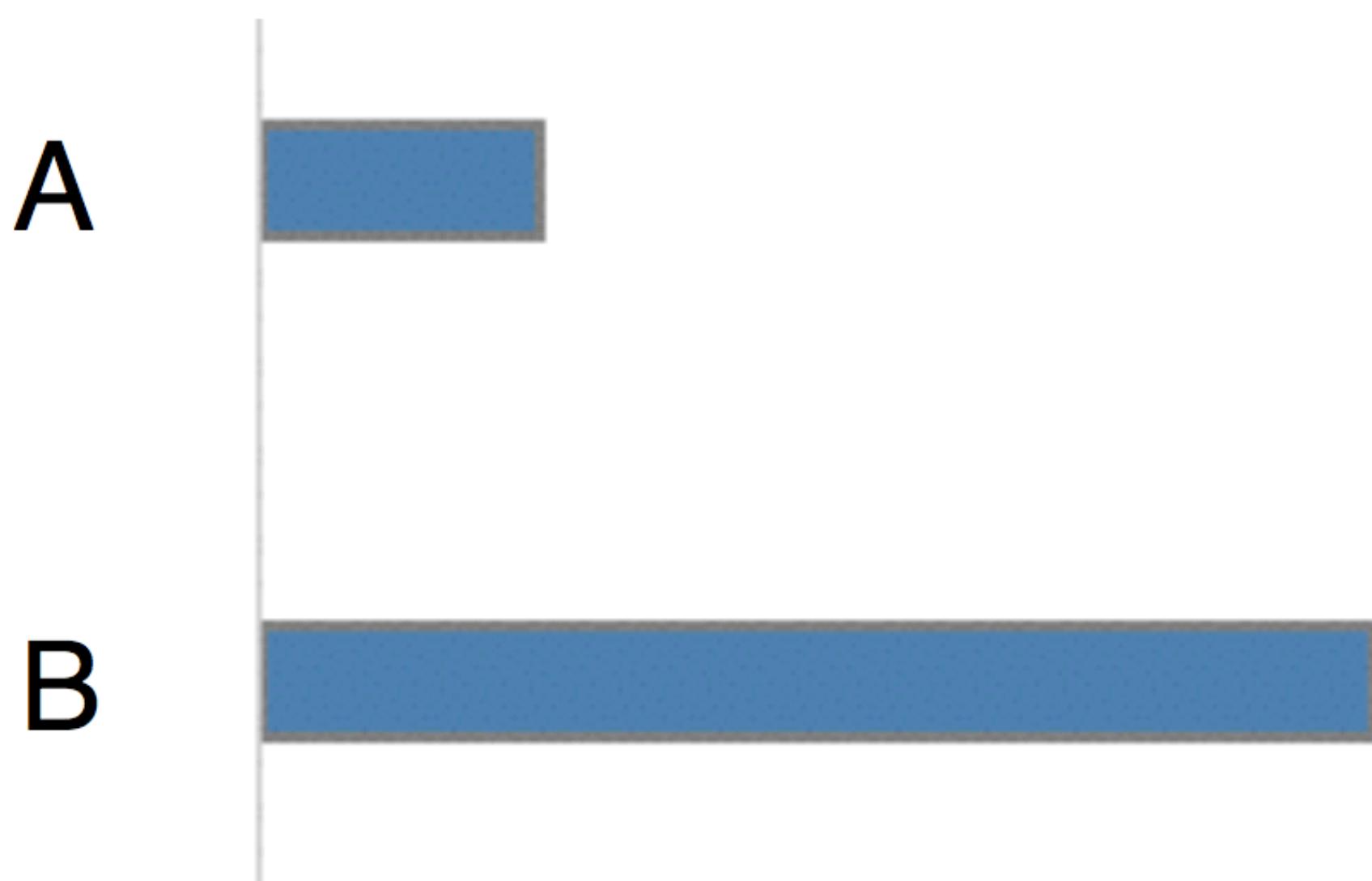


## Test — How much longer?

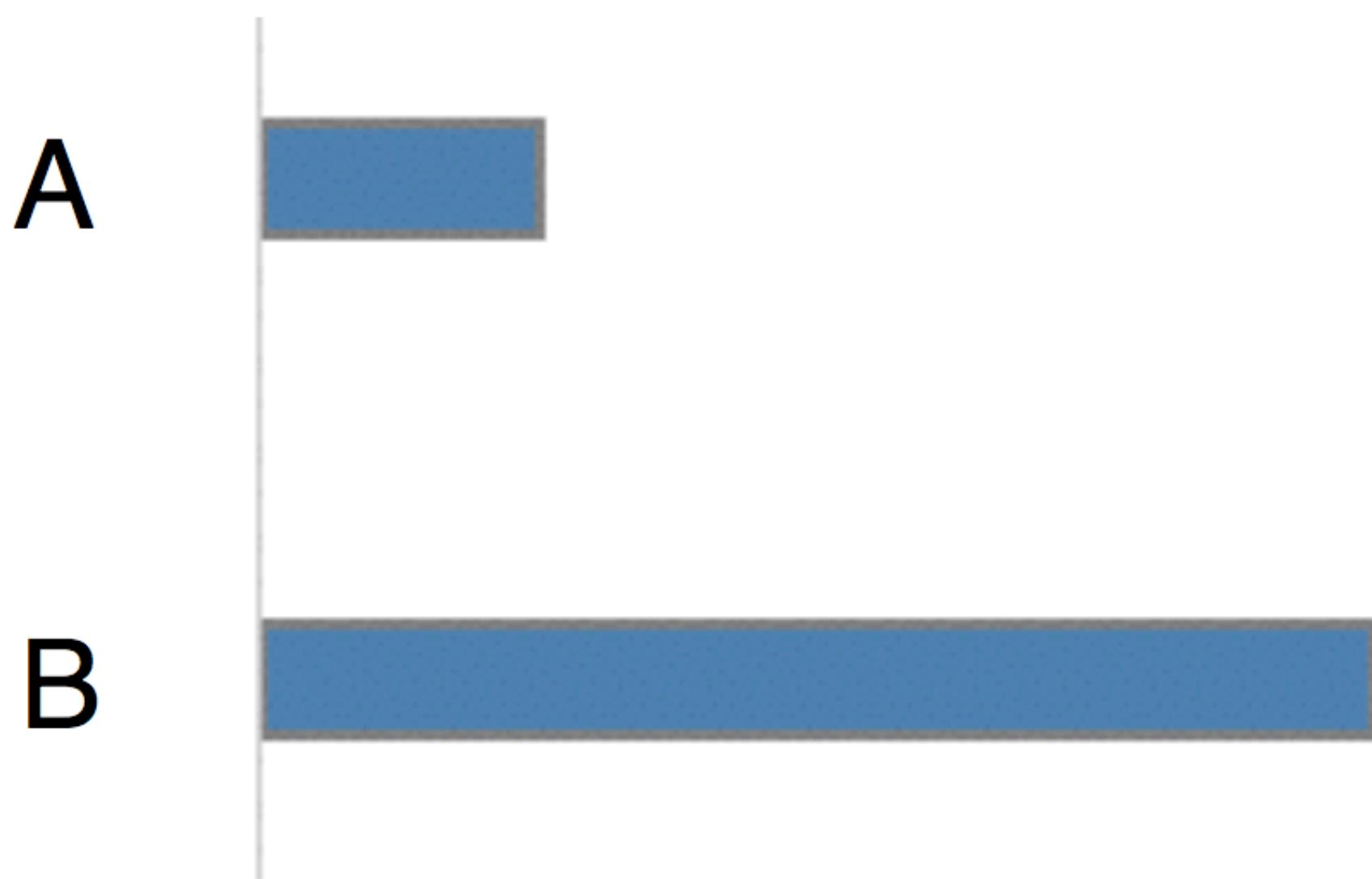


→ **2X**

# Test — How much longer?

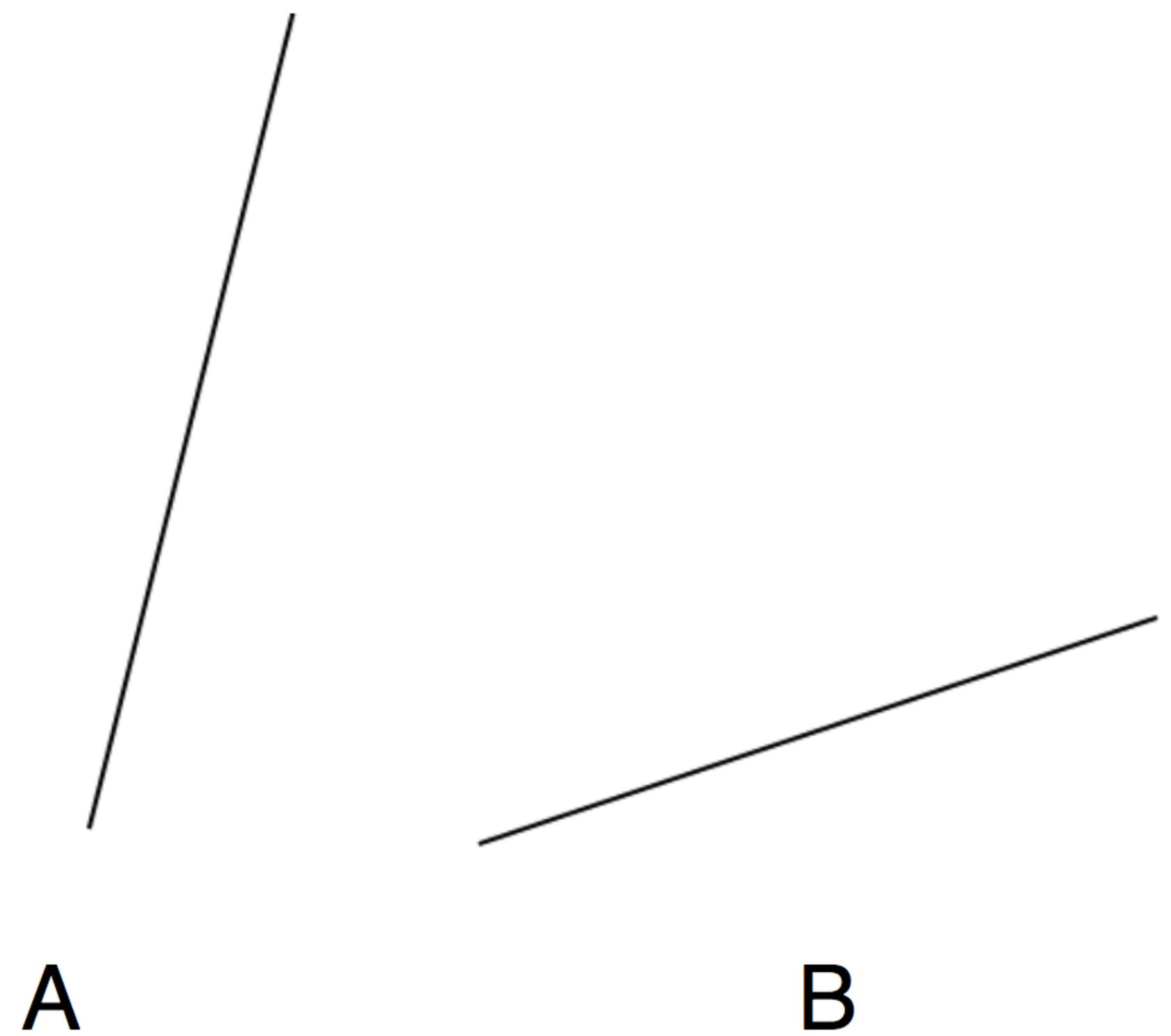


# Test — How much longer?

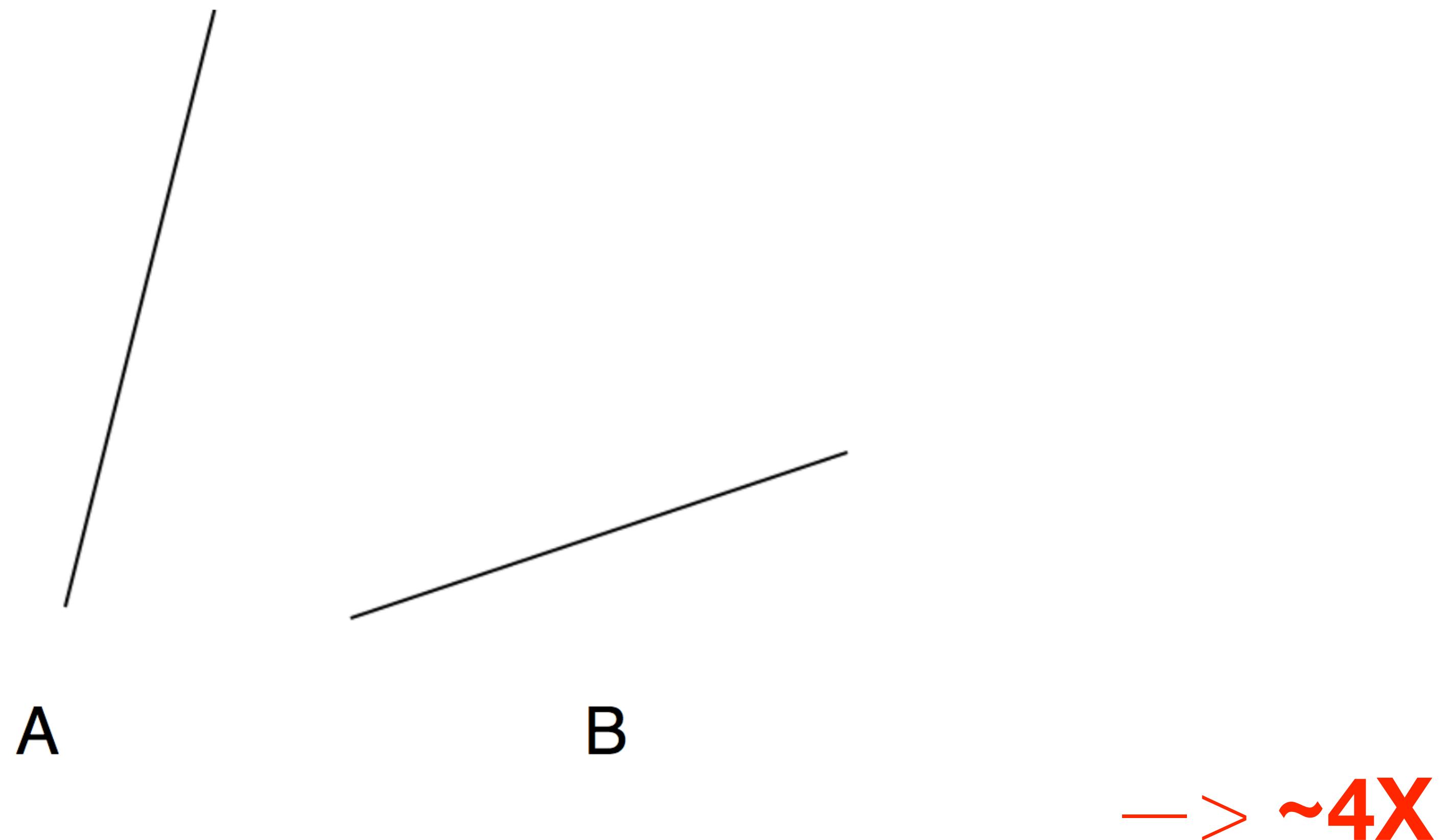


→ 4X

## Test — How much steeper?



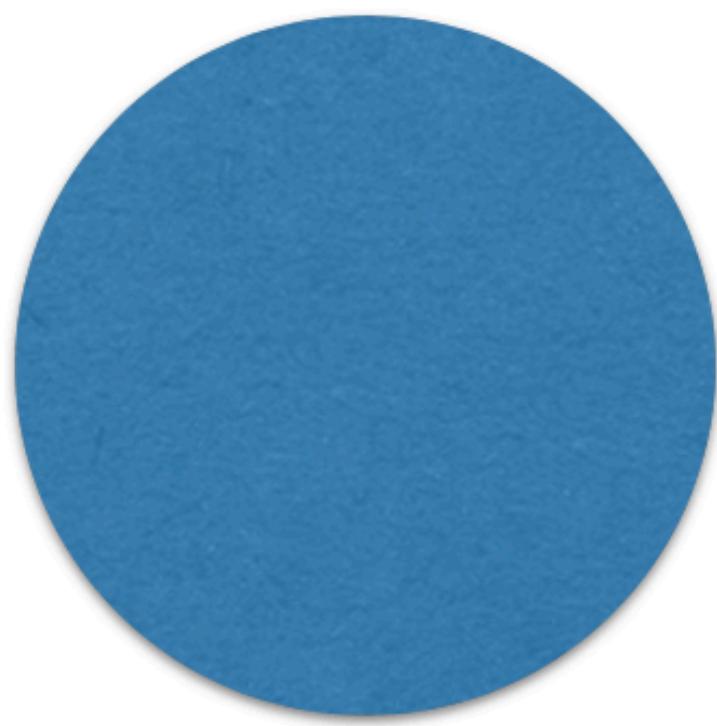
## Test — How much steeper?



## Test — How much larger (area)?



A

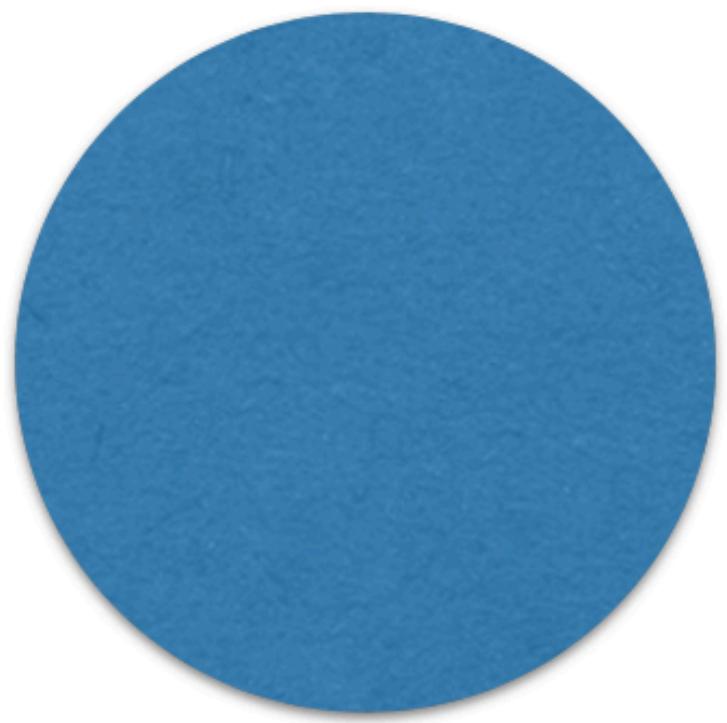


B

## Test — How much larger (area)?



A



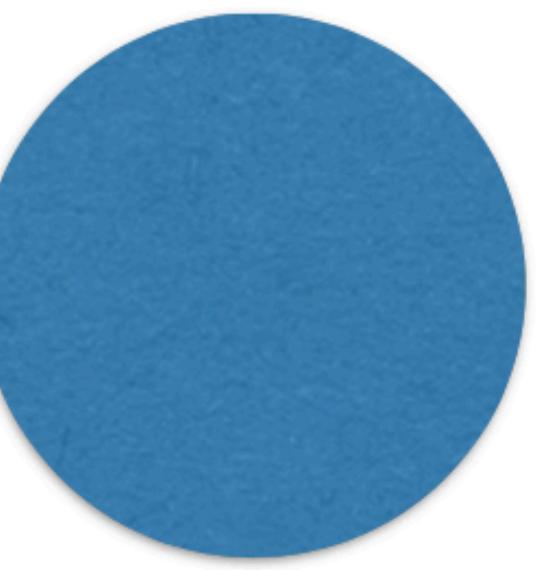
B

→ **5X**

## Test — How much larger (area)?



A

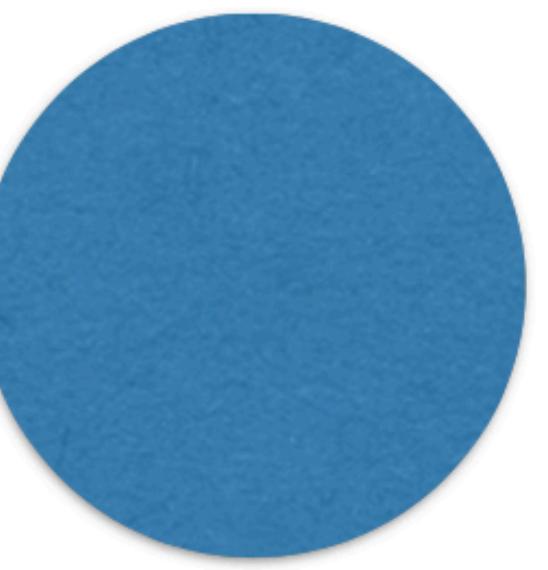


B

## Test — How much larger (area)?



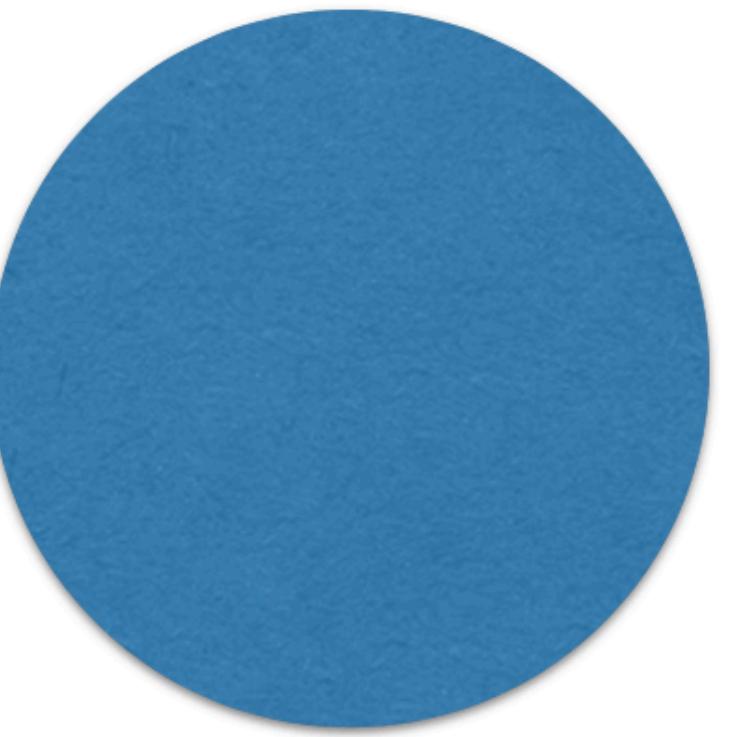
A



B

→ 3X

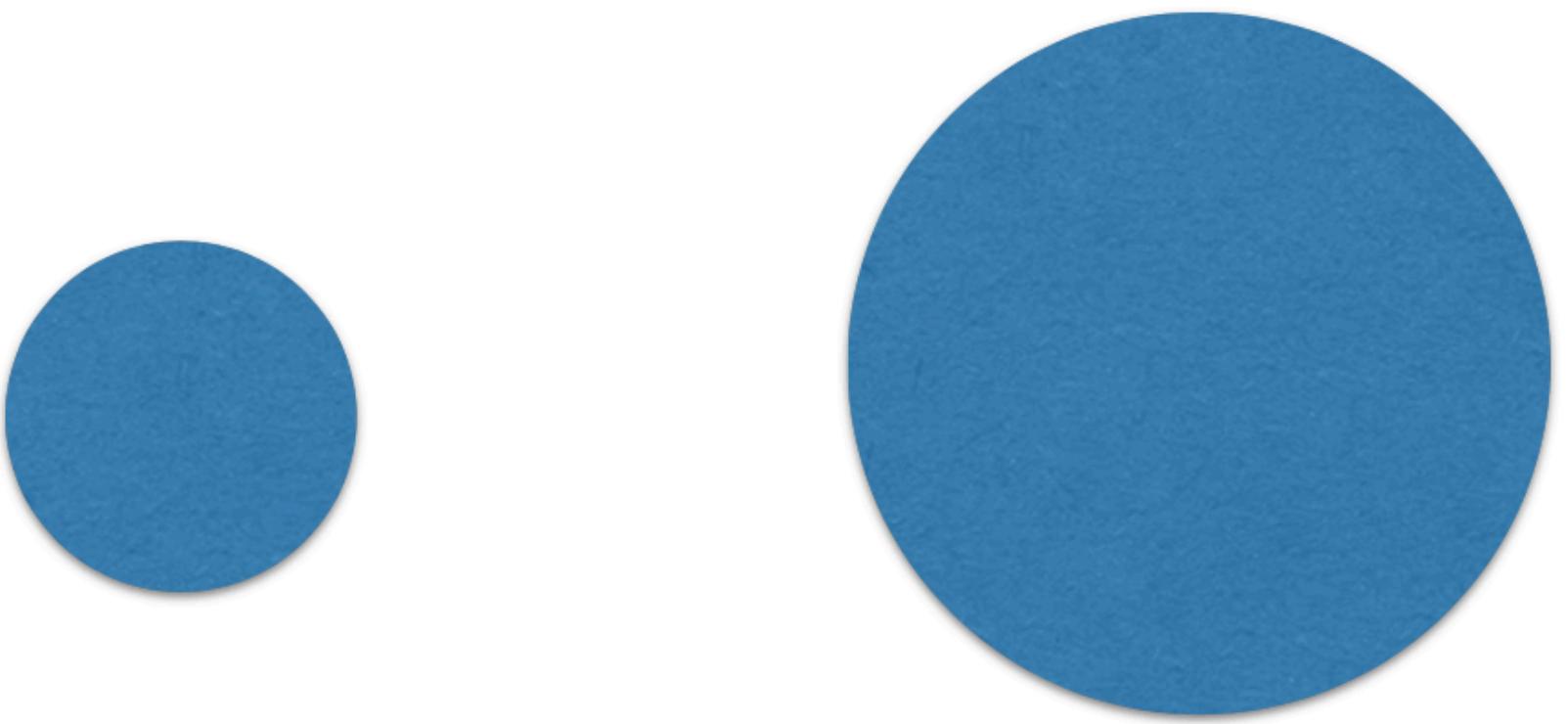
Test — **How much larger (diameter)?**



A

B

## Test — How much larger (diameter)?



A

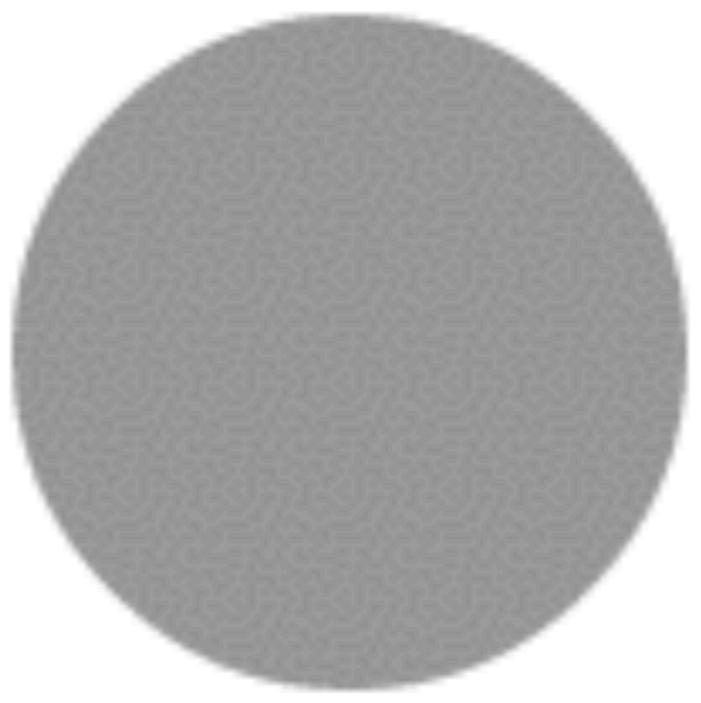
B

→ **2X**

## Test — How much darker?



A

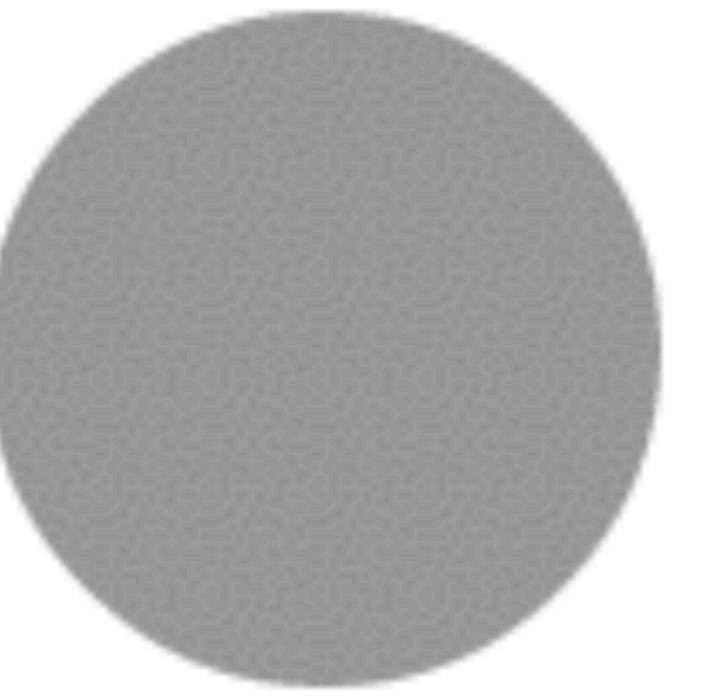


B

## Test — How much darker?



A



B

→ **2X**

# Assignment 2 — Review

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