

# Data Visualisation

Narrative & Interactive Data-Viz in Python

18th & 19th Sept 2019  
Mumbai, IN

Workshop Notes

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# Workshop Introduction

- **Objectives:** Intent & learning outcomes
- **Context::** Purpose & role of data visualisation, narrative & interactive types, tools & python
- **Approach:** Conceptual & exercise based, group formations
- **Intros:** Participant & facilitator introductions
- **Expectations:** Alignment & discussion
- **Checkin:** Python setup and installation readiness

# Objectives

- Understand the value of data visualisation and the role it plays in business analytics and decision making
- Learn the theory of data visualisation including grammar, types, color, annotation, flow, animation, interaction etc.
- Build an understanding of visual perception and cognition to gain an intuitive sense of how data visualisation work
- Get exposure to tools that can be used to create data-visualisation in python.

# Context

Learn through practice the two contexts in which data visualisation is used with business stakeholders

- Narrative visualisation (say, telling a compelling data-story in a presentation)
- Interactive visualisation (say, allowing business user to visually explore a complex data-set or a model)

# Approach

- The workshop is structured with a mix of conceptual learning (40%) and practice sessions (60%)
- This is a hands-on workshop and we will learn by using python and notebook
- There will be a case-study based approach - Telco Churn Example - to learn from.
- Each day will have four main sessions: see session plan next

# Day 1 Sessions

- **Workshop Introduction** (0930 - 1000)
- **Session #1: Value of Data Visualisation** (1000 - 1120)
- Break (1120 - 1140)
- **Session #2: Tools & Abstractions for Data Visualisation** (1140 - 1300)
- Lunch (1300 - 1400)
- **Session #3: Theory of Data Visualisation** (1400 - 1520)
- Break (1520 - 1540)
- **Session #4: Guidelines for Better Data Visualisation** (1540 - 1700)
- **Day One Summary** (1700 - 1730)
- **Data-Story Group Exercise** (1730 - 1900)

# **Day 2 Sessions**

- **Recap & Questions** (0930 - 0950)
- **Data-Story Presentations** (0950 - 1020)
- **Session #5: Crafting Visual Stories with Data** (1020 - 1120)
- Break (1120 - 1140)
- **Data-Story Rework** (1140 - 1210)
- **Session #6: Interactivity** (1210 - 1320)
- Lunch (1320 - 1420)
- **Session #7: Explorable Vis for Business Users** (1420 - 1540)
- Tea Break (1540 - 1600)
- **Session #8: Putting together an Interactive Application** (1600 - 1720)
- **Overall Summary & Way Forward** (1720 - 1800)

# Introduction & Expectations

- Tell us about yourself
  - Name & Role
  - Experience with Python
  - Experience with Analytics
  - One thing you want to learn from the workshop

# **Group Formation**

- Groups of 4 or 5
- Mixed experience of Python & Analytics
- For the data-story work & presentation

# Installation Check In

Workshop Repo

<https://github.com/amitkaps/data-vis-workshop>

- Did you follow the instruction in the README.md?
- Any issues you faced?

# Narrative Visualisation

# #1: Value of Data Visualisation

# War Stories & Killer Charts



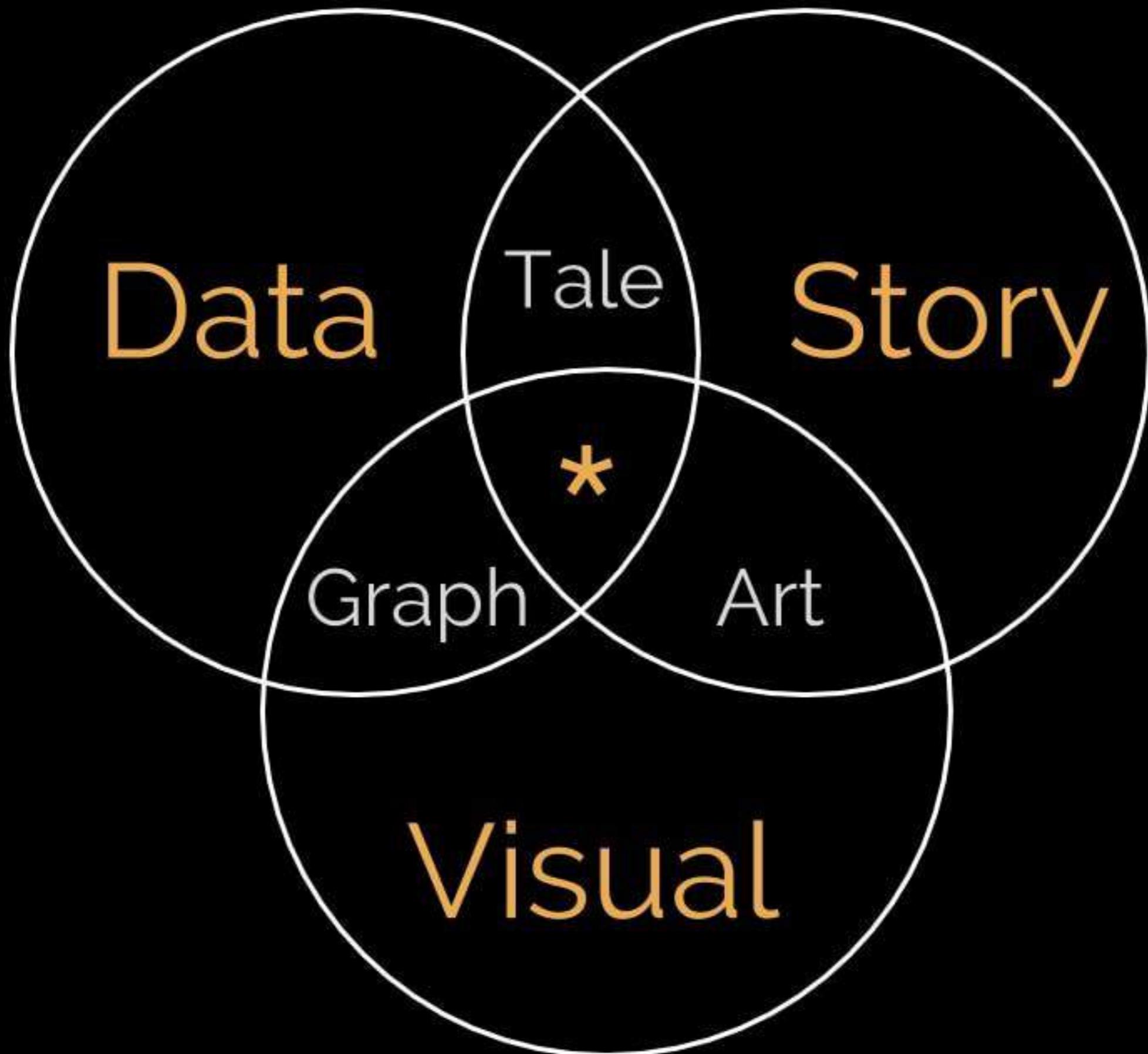
**analysis  
numbers  
argument**

Humans are  
**pattern-seeking**  
**story-telling**  
animals.

**analysis Synthesis**

**numbers Visuals**

**argument Story**



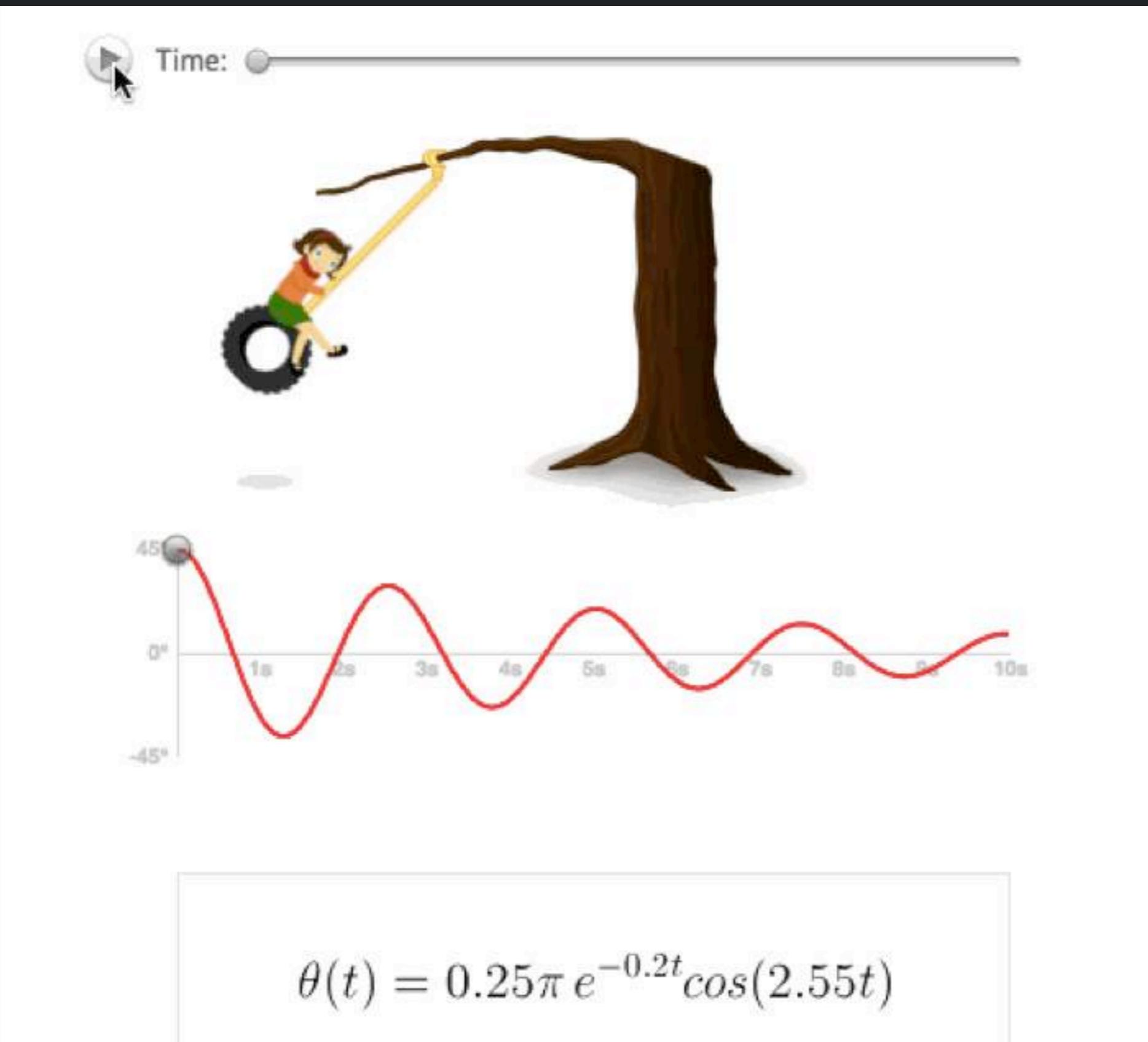
# **What is visualisation?**

# **Exercise: Visualise this data in at least 10 different ways - using paper & pen**

Area	Sales	Profit
North	5	2
East	25	8
West	15	6
South	20	5
Central	10	3

**Visualisation** is the  
**transformation** of the  
**symbolic** into **geometric**.

— McCormick et al.



# Start with Data

Data

Area	Sales
North	5
East	25
West	15
South	20
Central	10

# Identify the Variables

Data		Variables	
Area	Sales	x	y
North	5	1	5
East	25	2	25
West	15	3	15
South	20	4	20
Central	10	5	10

x (Nominal) = Area  
y (Quantitative) = Sales

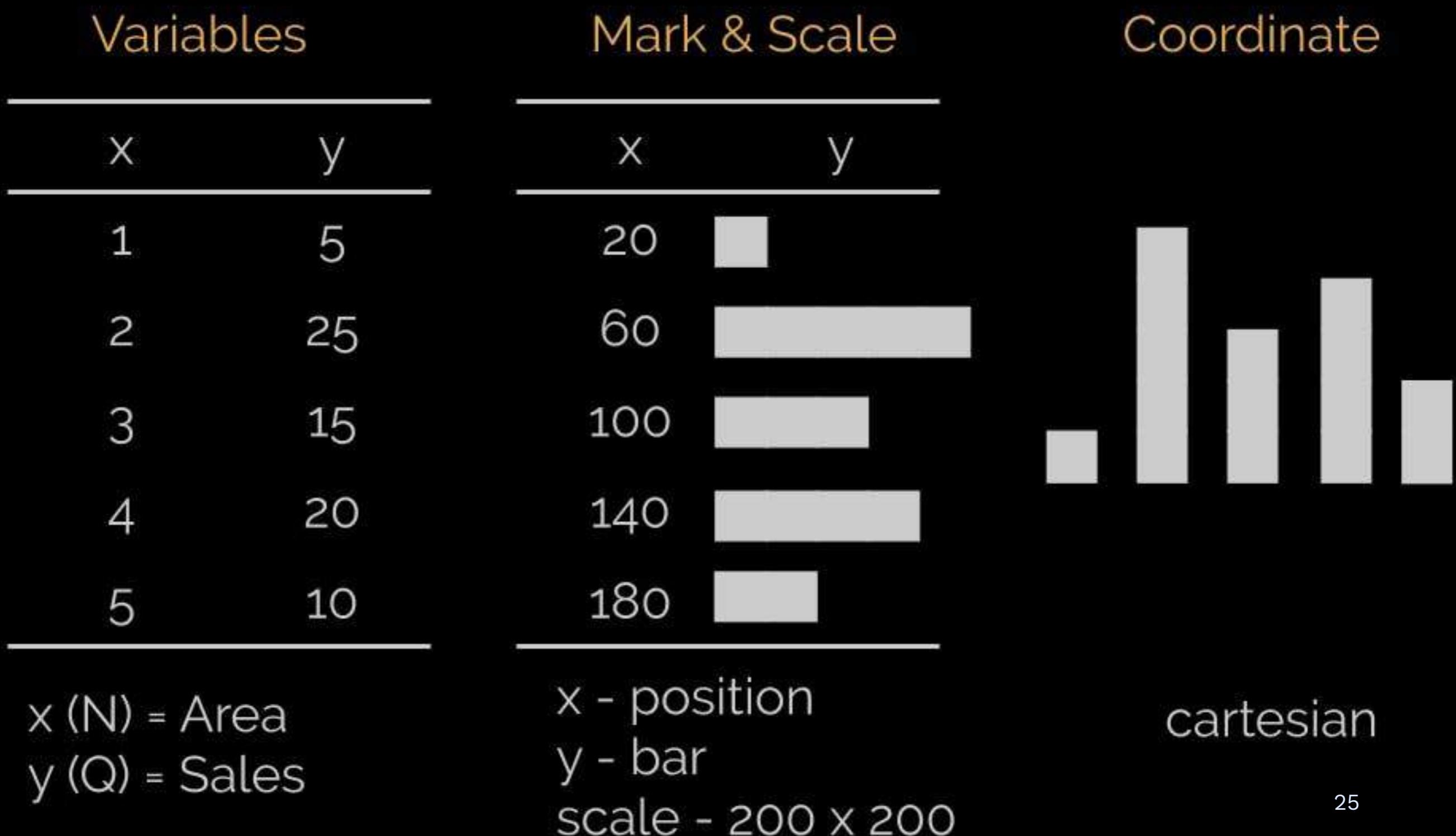
# Pick Marks and Scales

Data		Variables		Mark & Scale	
Area	Sales	x	y	x	y
North	5	1	5	20	
East	25	2	25	60	
West	15	3	15	100	
South	20	4	20	140	
Central	10	5	10	180	

x (N) = Area  
y (Q) = Sales

x - position  
y - bar  
scale -  $200 \times 200$

# Map to Coordinate



# Example #1

Points



Line



Bar



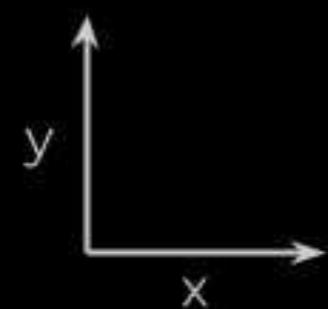
Bar - Stacked



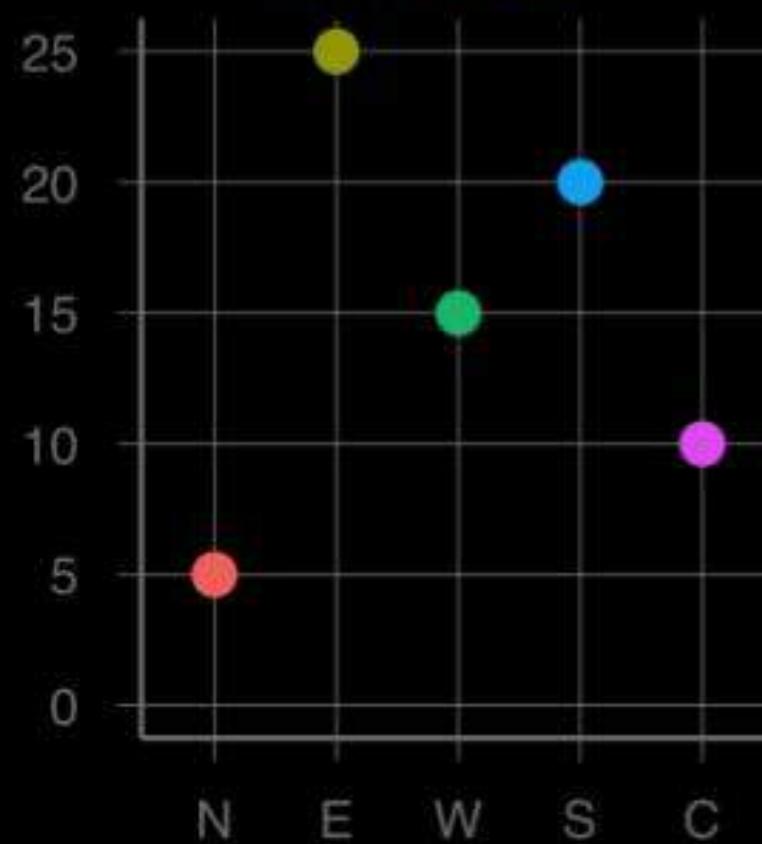
Bar - Stagger



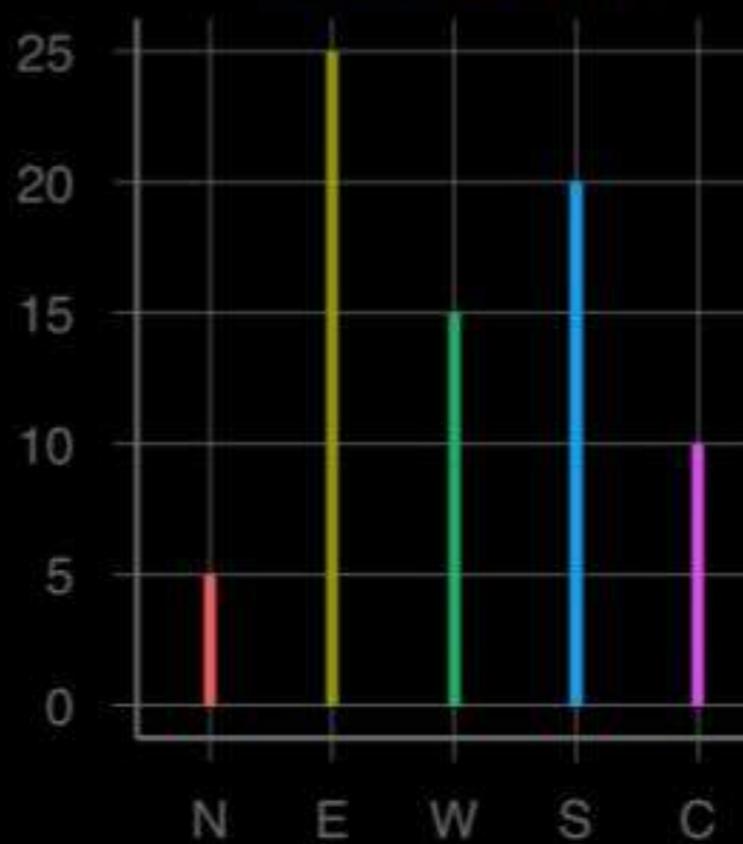
Coordinates  
Cartesian



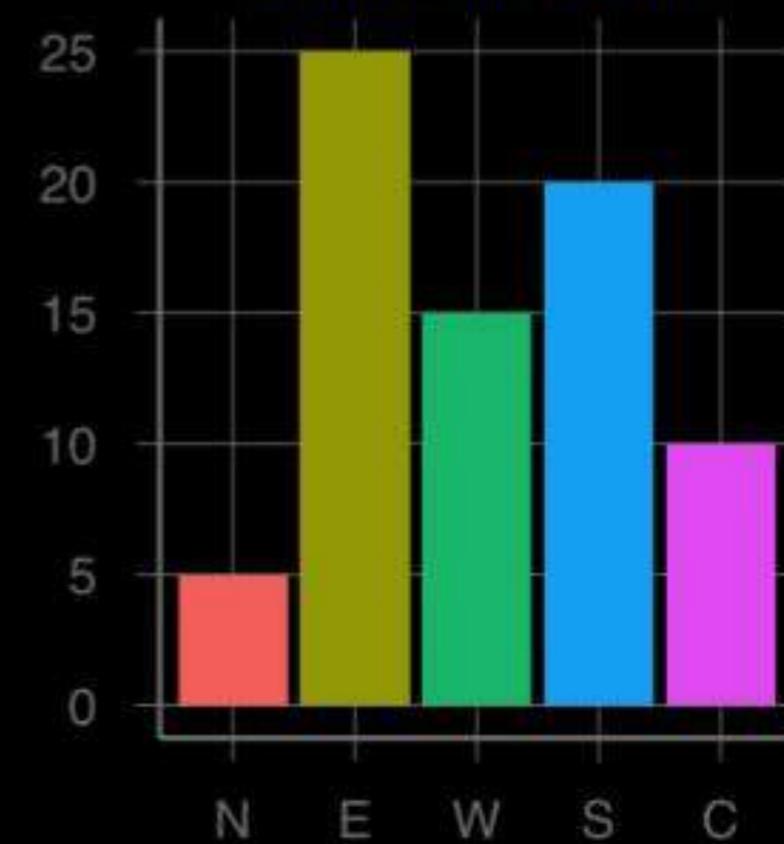
### Dot Plot



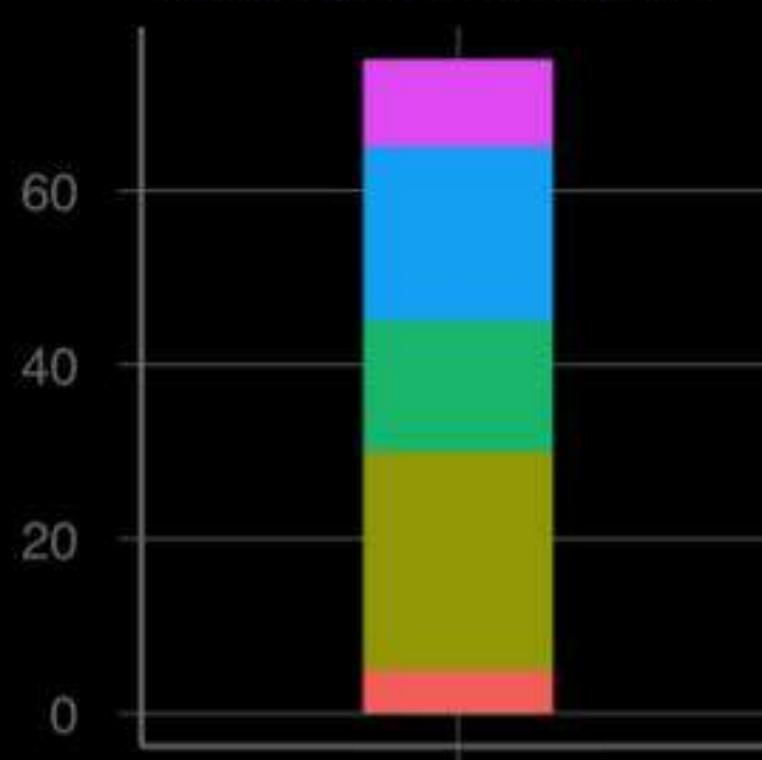
### Line Chart



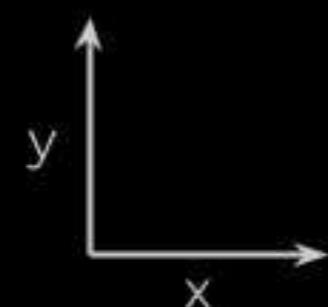
### Column Chart



### Stacked Column



### Waterfall



# Vis Examples: 1-5

Points



Line



Bar



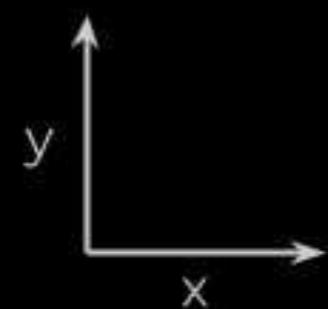
Bar - Stacked



Bar - Stagger



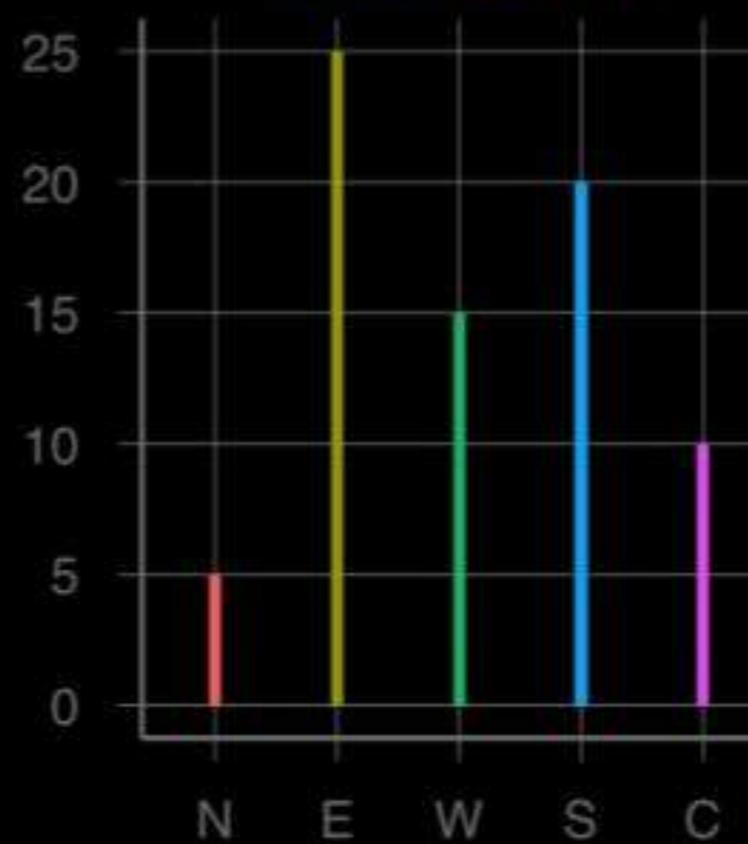
Coordinates  
Cartesian



### Dot Plot



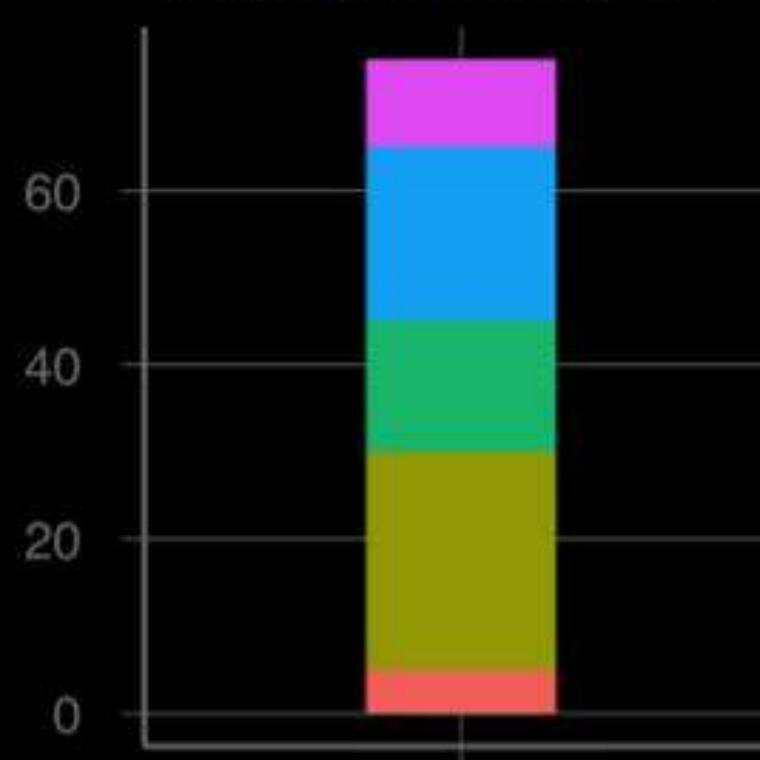
### Line Chart



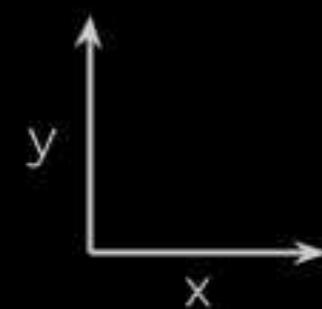
### Column Chart



### Stacked Column



### Waterfall



# Vis Examples: 6-10

Points



Line



Bar



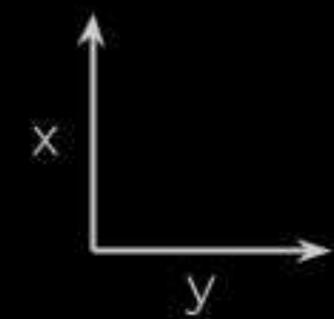
Bar - Stacked



Bar - Stagger



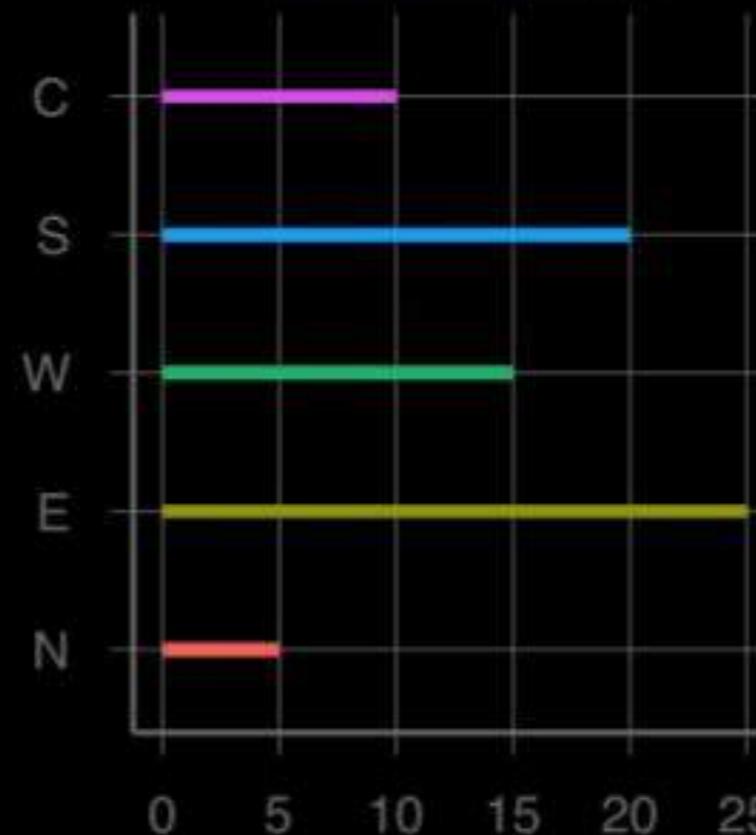
Coordinates  
Cartesian - Flip



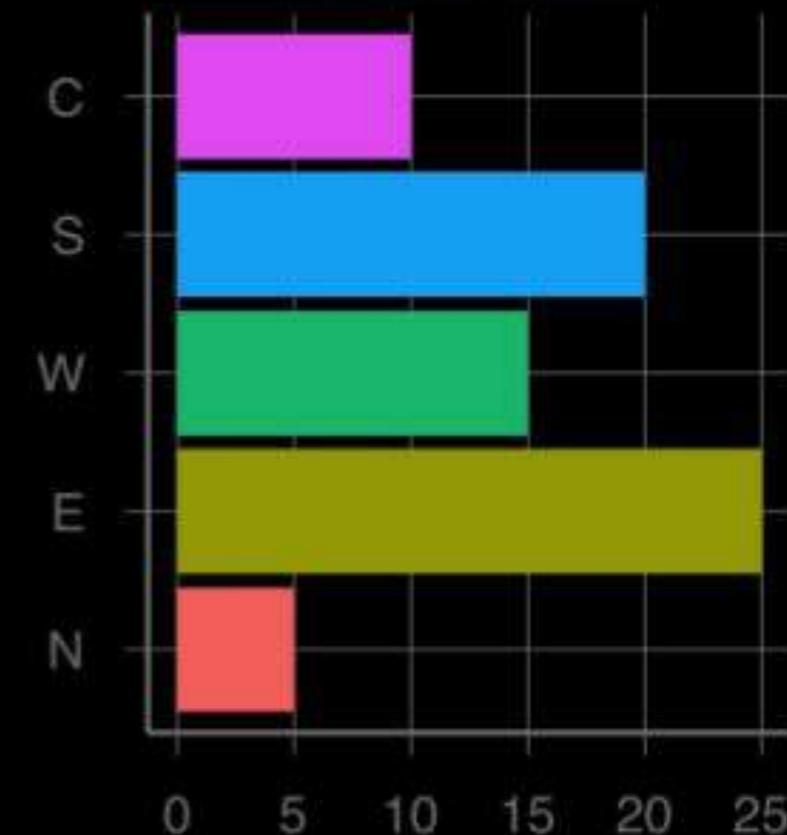
### Dot Plot



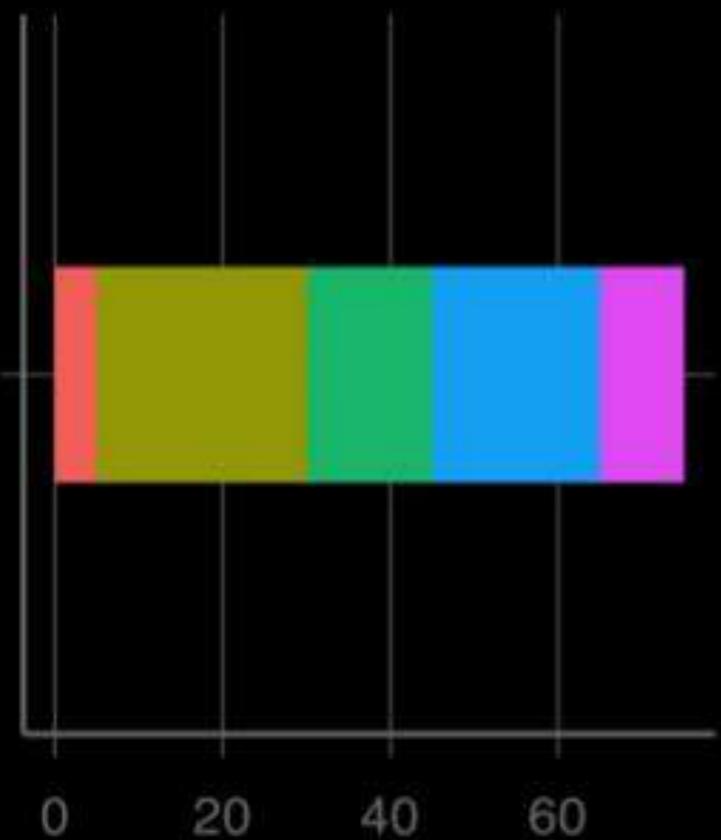
### Line Chart



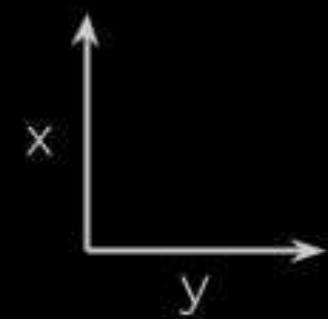
### Bar Chart



### Stacked Bar



### Cascade



# Vis Examples: 11-15

Points



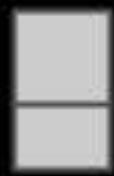
Line



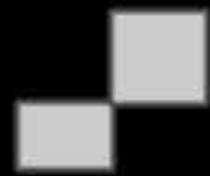
Bar



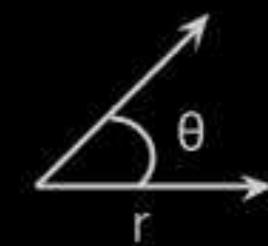
Bar - Stacked



Bar - Stagger

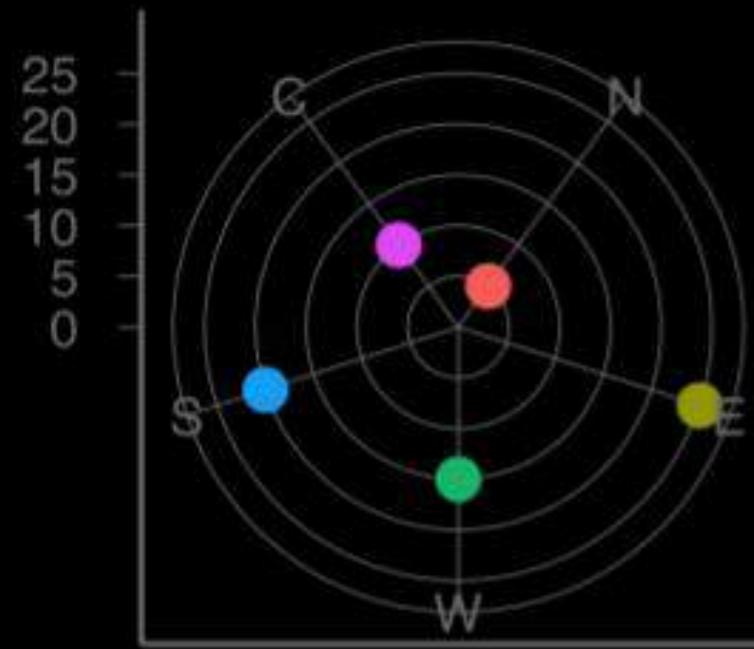


Coordinates  
Polar - x

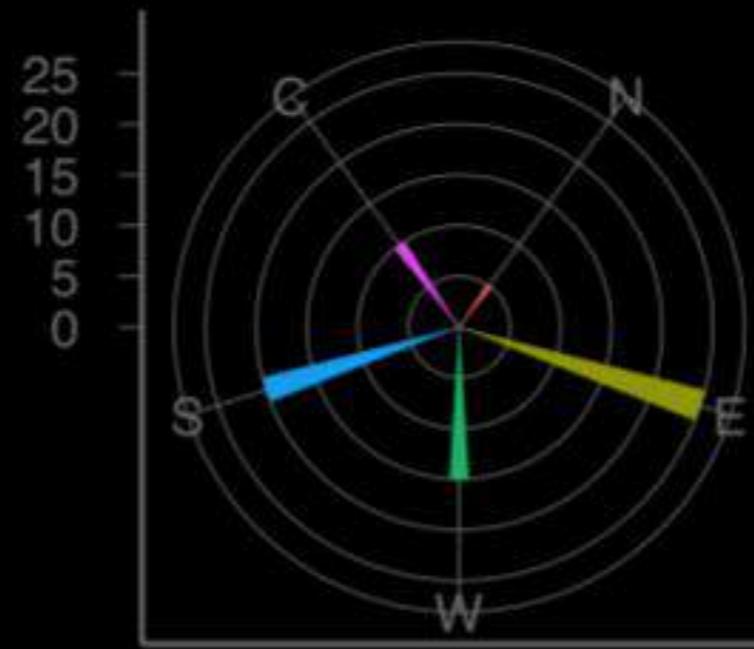


$$\begin{aligned}x &= \theta \\y &= r\end{aligned}$$

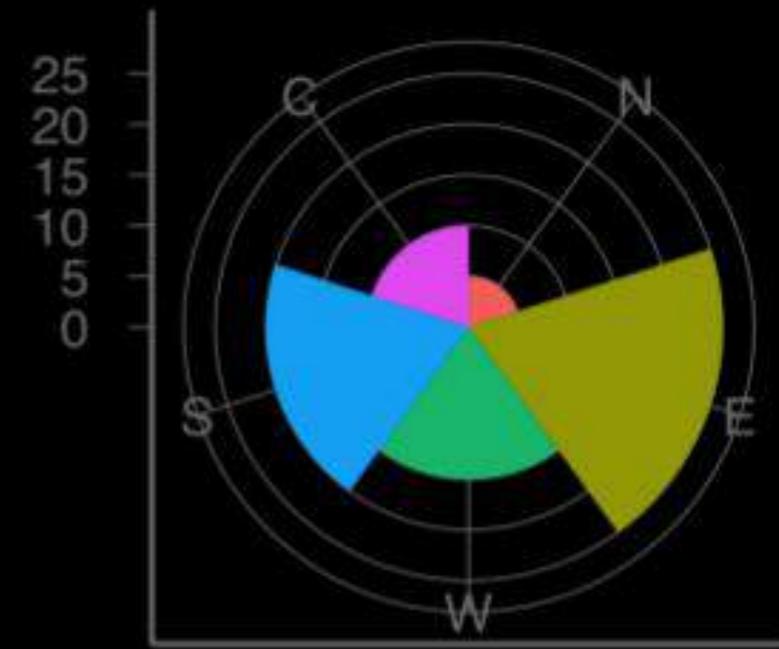
Marked Radar



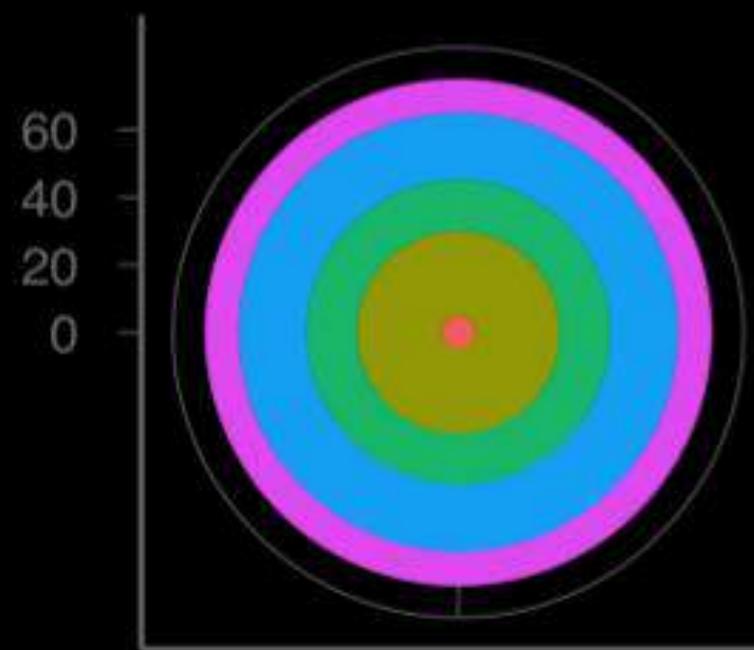
Line Radar?



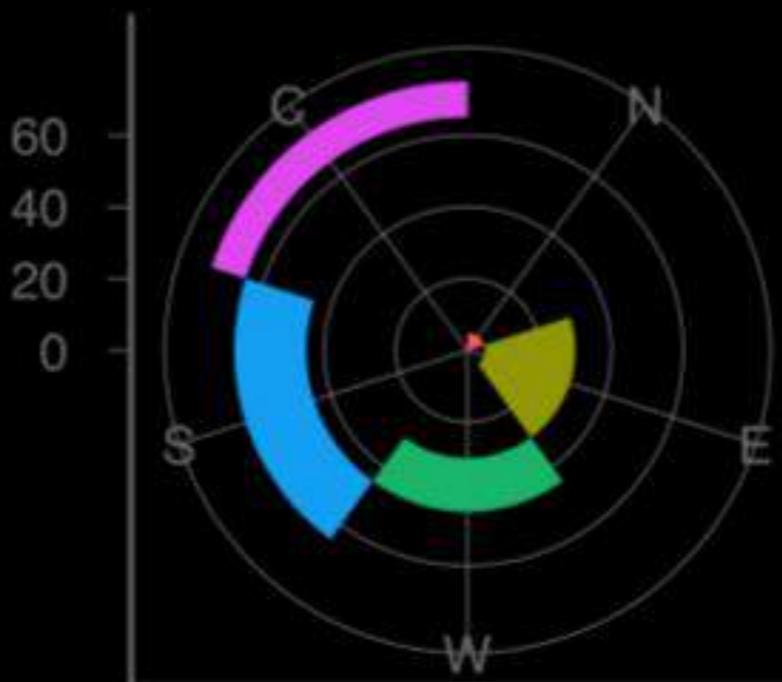
CoxComb



Bullseye



Polar Waterfall?



$$\begin{array}{l} \text{Diagram: A polar coordinate system with radial axis } r \text{ and angular axis } \theta. \\ \text{Equations: } x = \theta, y = r \end{array}$$

# Vis Examples: 16-20

Points



Line



Bar



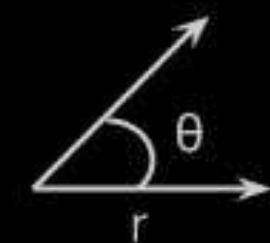
Bar - Stacked



Bar - Stagger

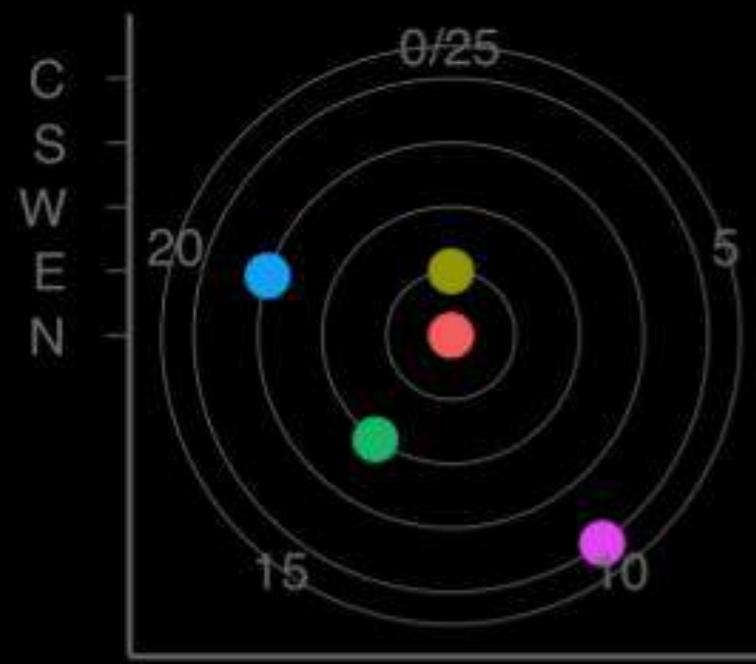


Coordinates  
Polar - Y

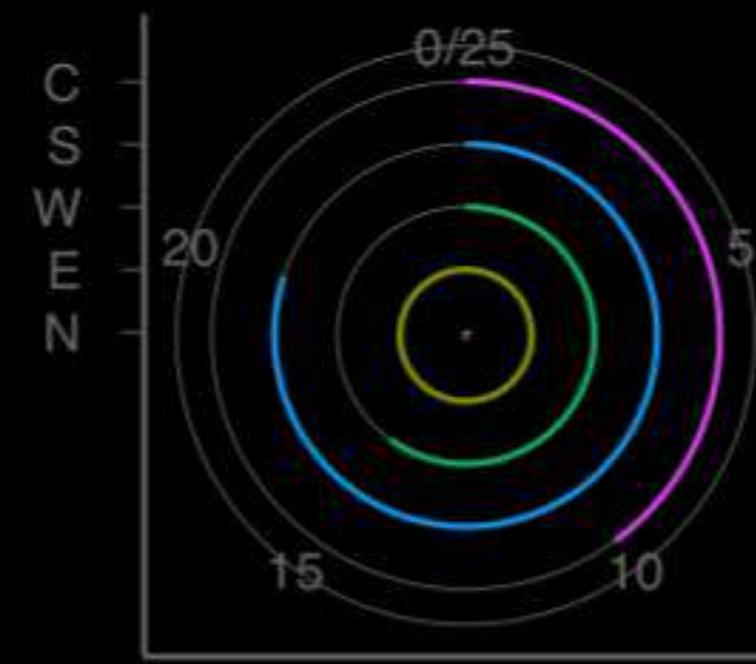


$$\begin{aligned}x &= r \\y &= \theta\end{aligned}$$

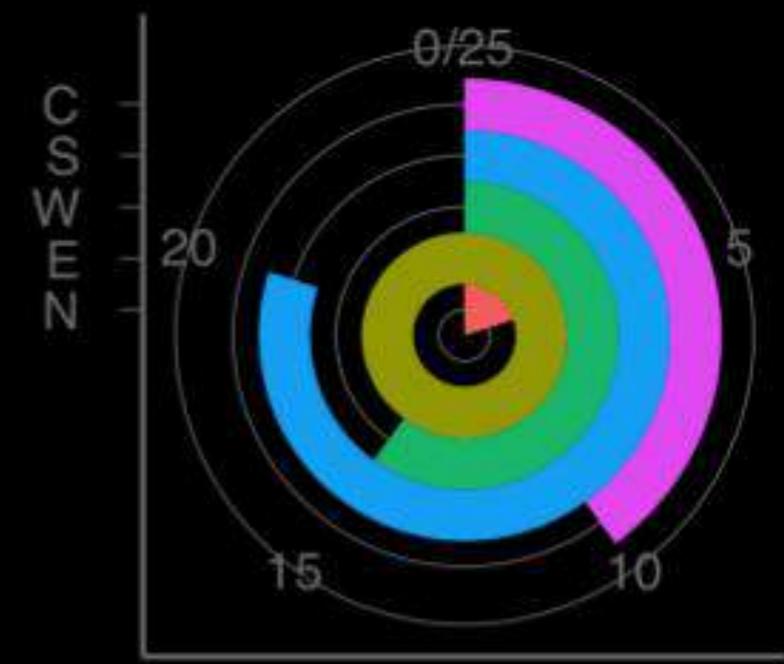
Target?



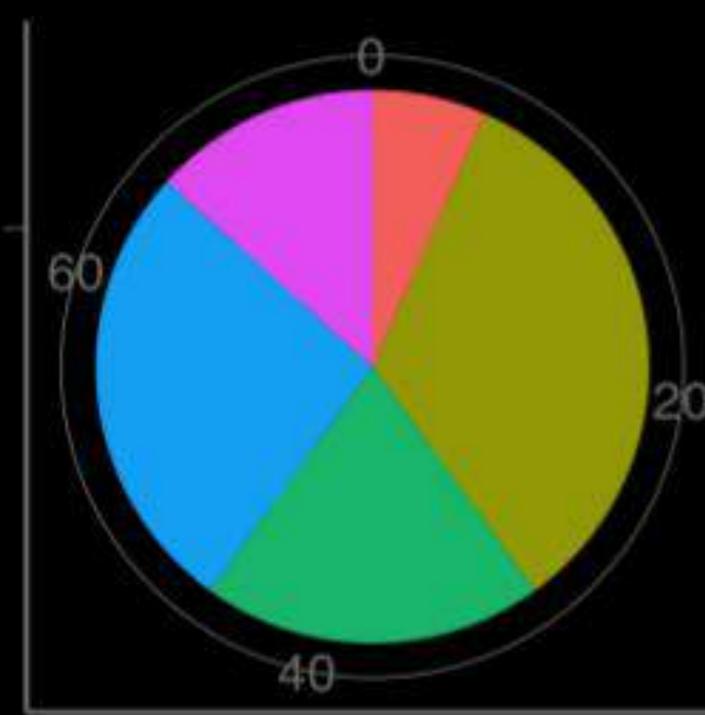
Wind Rose?



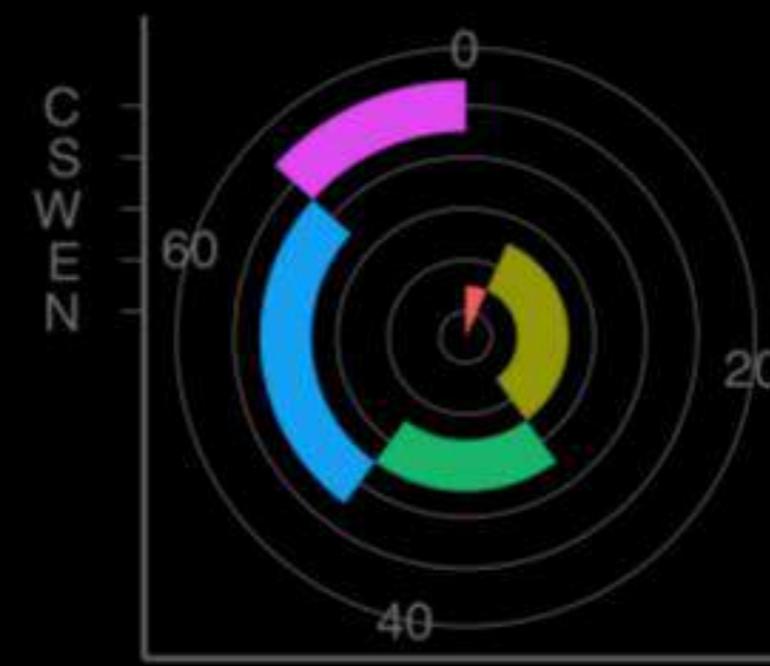
Wind Rose



Pie Chart



Polar Cascade?



$$\begin{array}{l} \text{Diagram showing a point } P \text{ in polar coordinates } (r, \theta) \text{ relative to the origin.} \\ x = r \cos \theta \\ y = r \sin \theta \end{array}$$

# Learning to See



**Visualisation** is the use of computer-generated,  
**interactive, visual representations** of **abstract data** to **amplify cognition.**

— Card, Mackinlay, & Shneiderman

# **Types of data visualisation with examples**

- Explore & Explain
- Static & Interactive
- Analytical & Emotive

Explanatory  
Narrative

Exploratory  
Interactive

Make decisions

Persuade | Tell a story

Share | Collaborate

Inspire

Expand memory

Answer questions

Find patterns

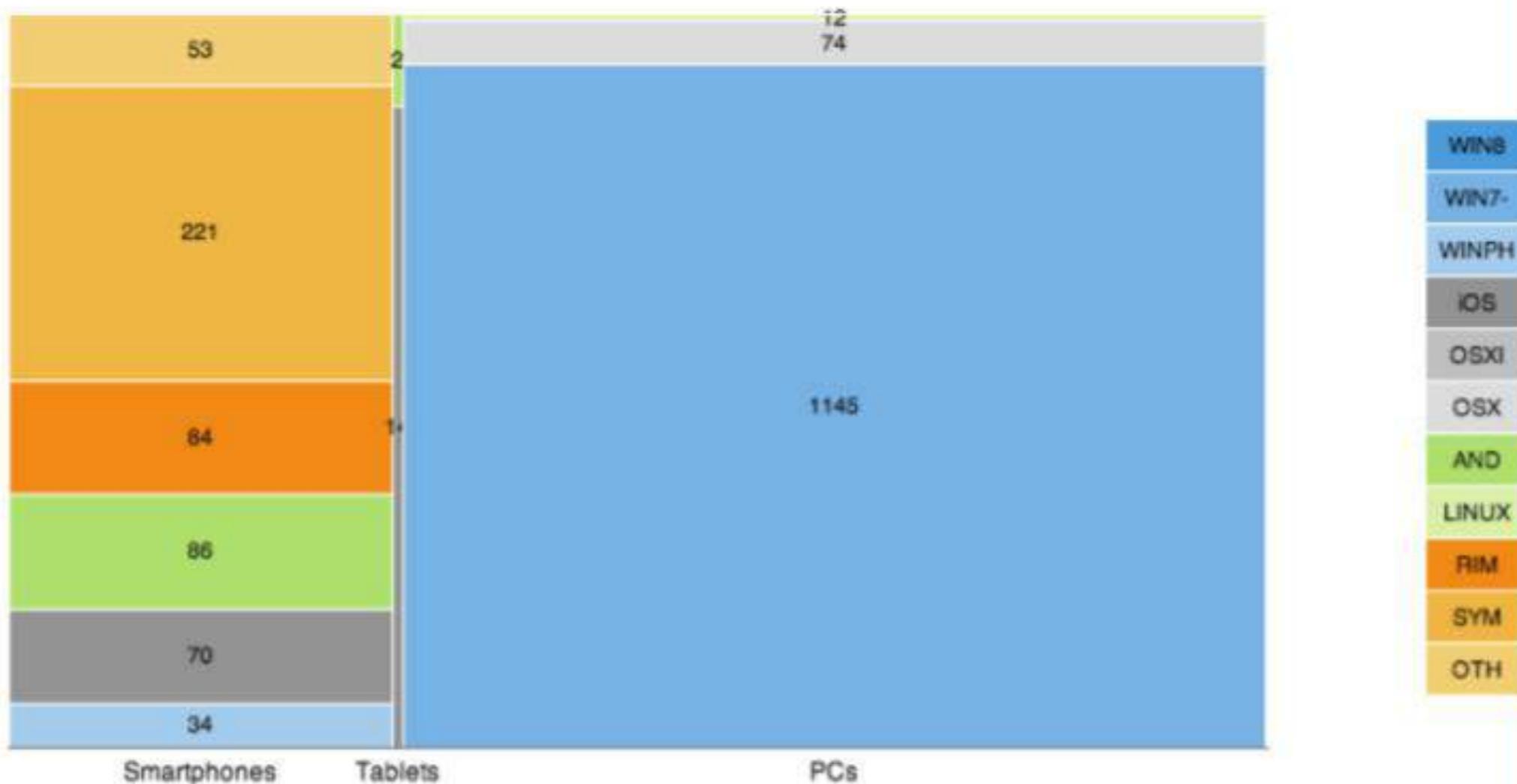
See data in context

# Explanatory

narrativeVIZ

## Growth of Android and Apple Ecosystem

Installed device estimates by OS in million units by Amit Kapoor



Choose the year to see the transition

2010 2011 2012 2013 2014 2015 2016 2017

Switch the devices on or off

Smartphones

Tablets

PCs

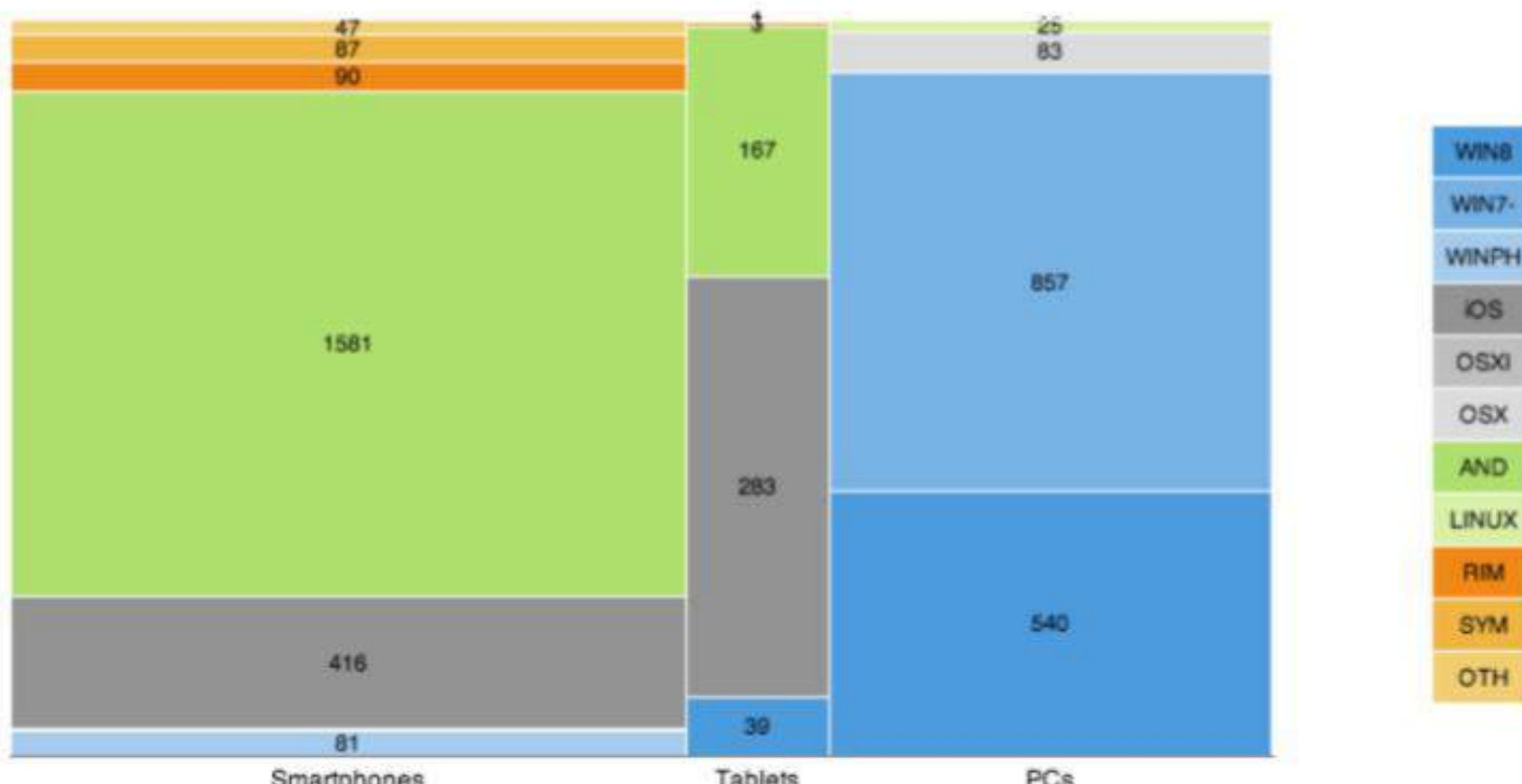
2010  
41

# Explanatory

narrativeVIZ

## Growth of Android and Apple Ecosystem

Installed device estimates by OS in million units by Amit Kapoor



Choose the year to see the transition

2010 2011 2012 2013 2014 2015 2016 2017

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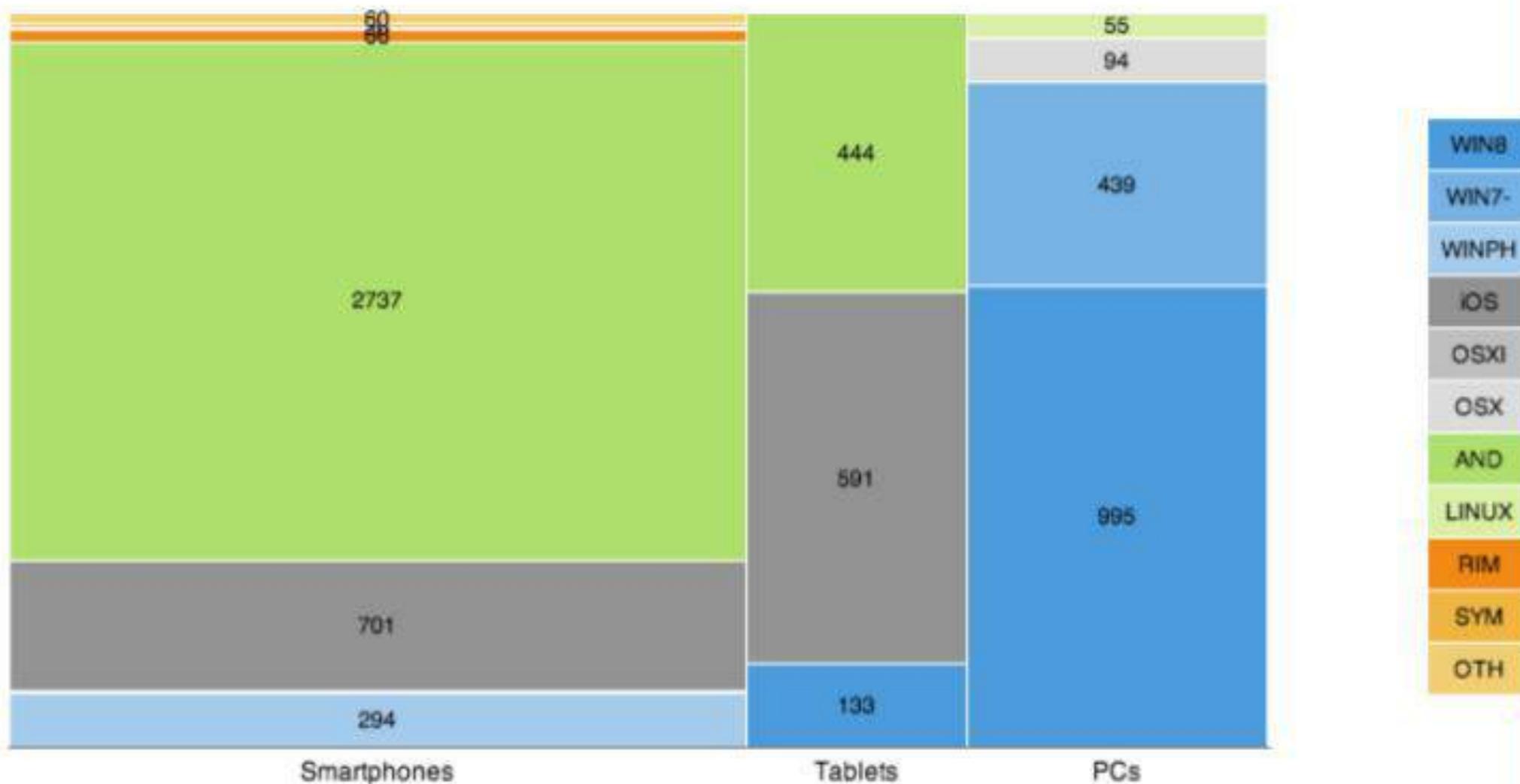
2014  
42

# Explanatory

narrativeVIZ

## Growth of Android and Apple Ecosystem

Installed device estimates by OS in million units by Amit Kapoor



Choose the year to see the transition

2010 2011 2012 2013 2014 2015 2016 2017

Switch the devices on or off

Smartphones

Tablets

PCs

2017  
43



type the digits of a pincode

Exploratory  
narrativeVIZ



# Exploratory

narrativeVIZ



Bannerghata Road, Bangalore 560076

560076

Exploratory  
narrativeVIZ

# Explanatory

Narrative

Strong Order

Heavy Messaging

Limited Interactivity

Author Driven

# Exploratory

Interactive

Weak Order

Light Messaging

Free Interactivity

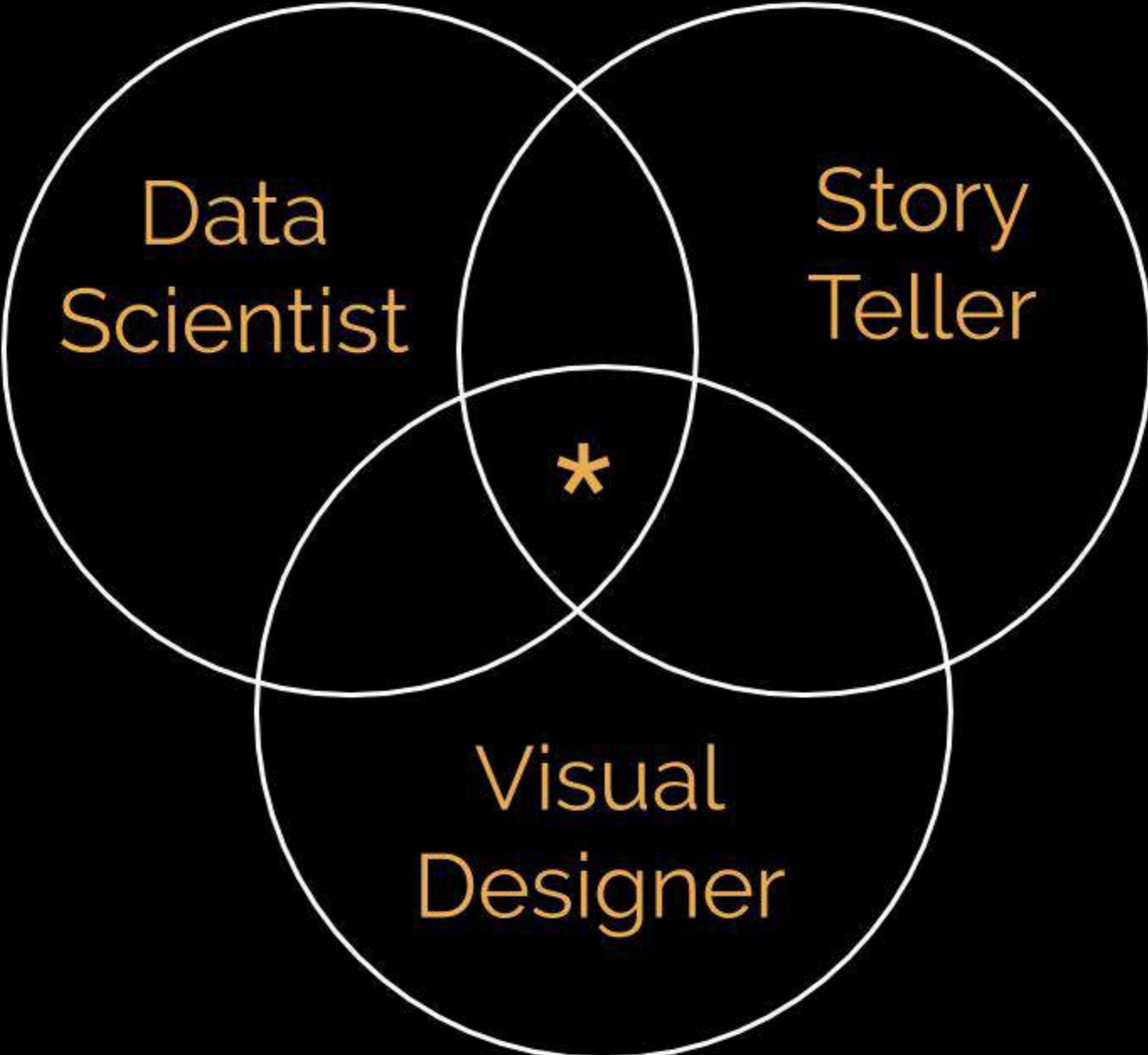
Reader Driven

# Tone of Visualization

Analytical &  
Pragmatic

Emotive &  
Abstract





Data  
Scientist

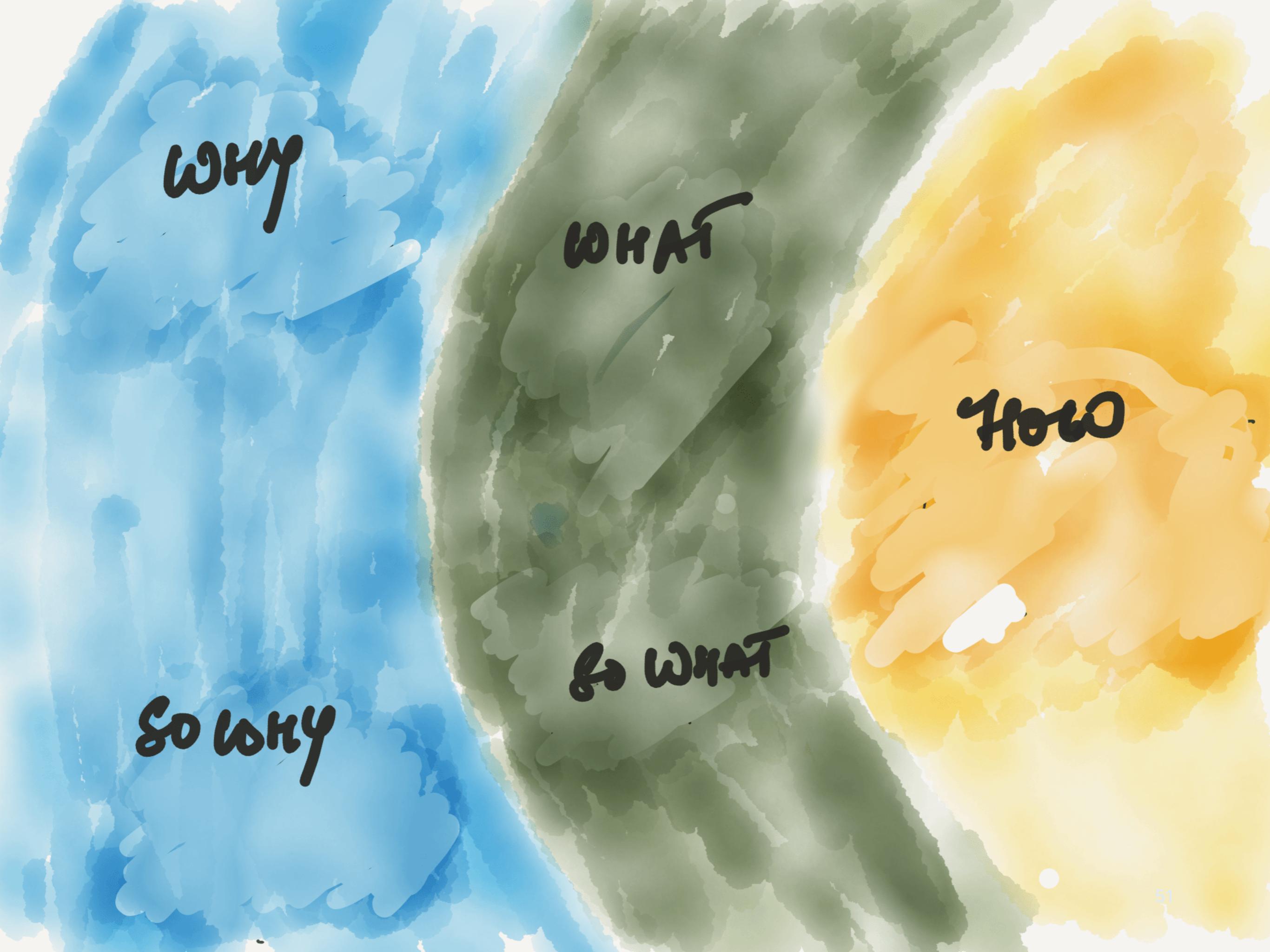
Story  
Teller

Visual  
Designer

\*

# **Analytics Process, Visualisation & Audience**

- Linkage with analytical problem solving process: Why - What - How - So What - So Why
- Audience needs and understanding: type, data & visual literacy
- Engagement in different context: personal, presentation & participation



why

what

how

do what

so why

# **Analytics Process**

1. **The Why** — Define the Problem
2. **The What** — Frame the Analytical Questions
3. **The How** — Conduct Analytics: Data-Model-Vis
4. **The So What** — Build the Insights
5. **The So Why** — Explain through Narrative

# why

PROBLEM DOMAIN  
SITUATION  
IMPACT / VALUE

# So Why

STORY VISUAL  
CASE FOR CHANGE

# what

QUESTIONS  
HYPOTHESES

# So What

FINDINGS  
INSIGHT

# How

DATA - ACQUIRE /  
TRANSFORM / EXPLORE  
MODEL - INQUISITIVE  
PREDICTIVE, CAUSAL

# Visualisation & Analytics

- Visual Exploration: Exploratory Data Analysis
- Insight Dashboard: Interactive Visualisation
- Visual Explanation: Narrative Visualisation

# Why

PROBLEM DOMAIN  
SITUATION, PROBLEM  
IMPACT / VALUE

VISUAL  
EXPLANATION

# So Why

STORY  
CASE FOR CHANGE

# What

QUESTIONS  
HYPOTHESES

INSIGHT  
DASHBOARD

# So What

FINDINGS  
INSIGHT

DATA

ACQUIRE  
REFINE  
TRANSFORM

# How

INFERENTIAL  
PREDICTIVE  
CAUSAL

VISUAL  
EXPLORATION

MODEL

# Audience Types

- **Analytics:** Rich data and modelling experience, high comfort with complex usage
- **Operational:** Mainly metrics driven with detailed drill-down requirements to build understanding
- **Business:** CxO or Business roles, looking for explanation and actions

# **Audiences & Participation Mode**

Visual Exploration:  
Personal mode with Analytics Audience

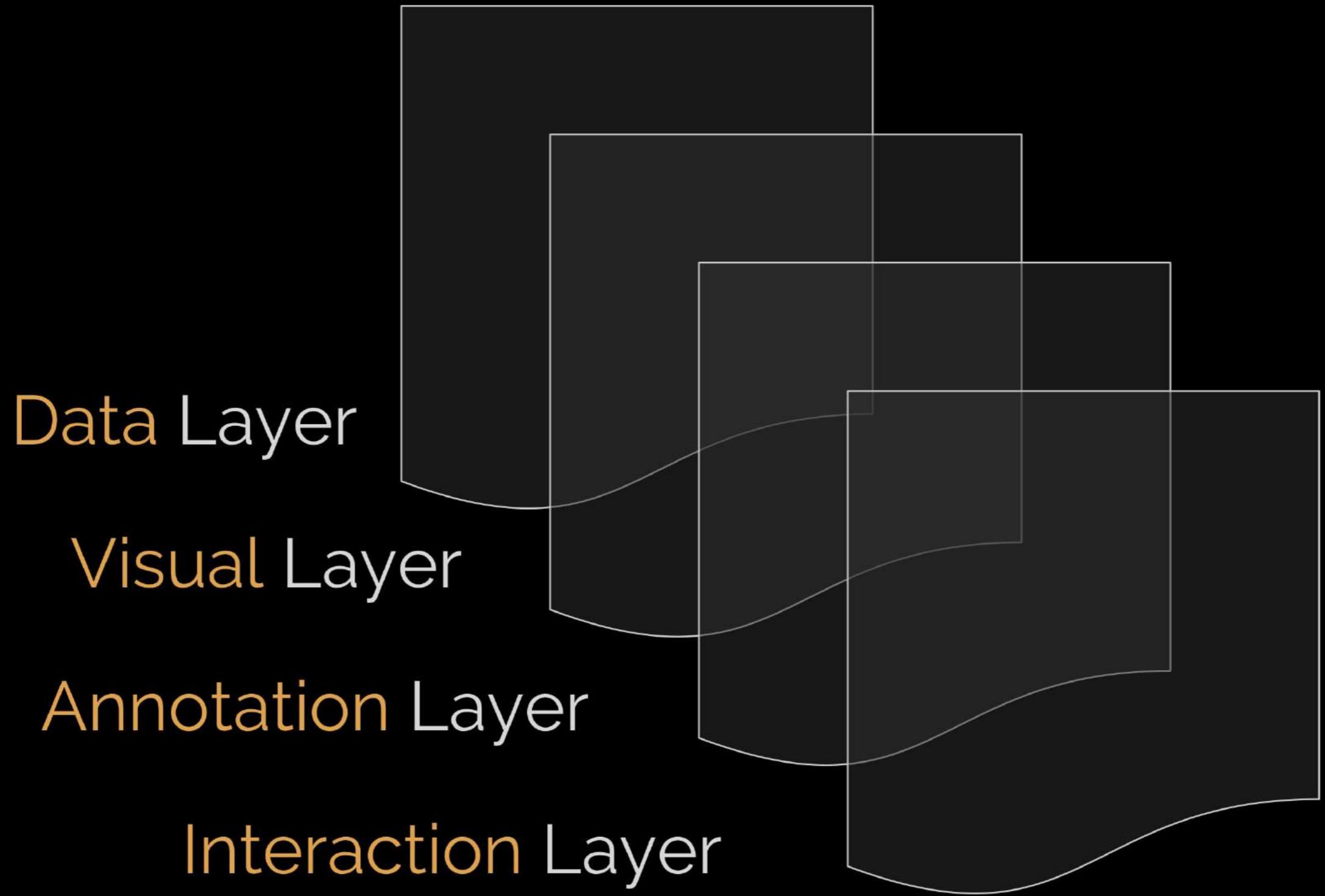
Insight Dashboard:  
Participative mode with Operational Audience

Visual Explanation  
Presentation mode with Business Audience

# **Four Layers of Visual Abstraction**

- Data Layer
- Visual Layer
- Annotation Layer
- Interaction Layer

# Layers of Abstraction



# Data Layer

## Types

- Categorical: Nominal, Ordinal
- Continuous: Temporal, Quantitative

## Transforms

- Reshape (e.g. tall  $\leftrightarrow$  wide)
- Aggregation (e.g. bins)
- Basic Stats (e.g. min, max, sum, ...)
- Calculate e.g. New Variables, Window
- Filtering, Sampling

# Visual Layer

- Marks: Points, Ticks, Lines, Bar, Area, Glyphs, Polygon, ...
- Channels: Position-X, Position-Y, Size, Color, Shape, Path, ...
- Scale: Linear, Log, ...
- Coordinate: Cartesian, Polar, Geo, Parallel
- Layout: Single, Facet, Multi-Chart

# Annotation Layer

- Title and Labels
- Axis and Tick marks
- Legends
- Grids and Reference Marks
- Text Annotation
- Story Elements

# Interaction Layer

- Select e.g. Highlight
- Explore & Navigate e.g. Pan, Zoom, Scale, Rotate
- Connect e.g Brushing & Linking
- Filter & Conditions e.g. Dynamic Queries
- Reconfigure e.g. Sorting
- Transition e.g. Scrolling, Layers
- Staging & Animation

# Data Types

- What are the types of data on which we are learning?
- Can you give example of say measuring temperature?

# Data Types e.g. Temperature

## Categorical

- Nominal: Burned, Not Burned
- Ordinal: Hot, Warm, Cold

## Continuous

- Interval: 30 °C, 40 °C, 80 °C
- Ratio: 30 K, 40 K, 50 K

# Data Types

## Categorical

- Nominal (N) e.g. OSX, Windows, Android
- Ordinal (O) e.g. Good, Better, Best

## Continuous

- Interval (zero arbitrary) e.g.
  - > Temporal (T): dates & time
  - > Geographic: latitude & longitude
- Ratio (Q) (zero fixed) e.g. length, mass

# Data Types: Operations

## Categorical

- Nominal: = , !=
- Ordinal: =, !=, >, <

## Continuous

- Interval: =, !=, >, <, -, % of diff
- Ratio: =, !=, >, <, -, +, %

# Data Structures

- Tabular (2d arrays) e.g. spreadsheet
- n-Dimension arrays e.g. images, videos
- Hierarchical data e.g. folders of text
- Spatial data e.g. for maps
- ...

# Common Data Types & Structure

Matrix	Example	Shape
2D	Tabular	(samples, features)
3D	Sequence (Time & Text)	(samples, steps, features)
4D	Images	(samples, height, width, channels)
5D	Videos	(samples, frames, height, width, channels)

# #2: Tools & Abstractions for Data Visualisation

## Tools Abstraction:

- Charting vs. Grammar vs. Canvas
- Static vs. Interactive
- SVG vs Canvas vs WebGL Rendering
- Data loading & transformation strategy

## Charting

Collection of fixed charts that require data to be shaped in a particular way

## Pixel

Paint directly on a canvas. Design & manage every pixel & interaction

## Charting

Collection of fixed charts that require data to be shaped in a particular way

## Pixel

Paint directly on a canvas. Design & manage every pixel & interaction

## Grammar

Collection of graphical primitives for composing data driven graphics

## Charting

Collection of fixed charts that require data to be shaped in a particular way

## Pixel

Paint directly on a canvas. Design & manage every pixel & interaction

## Grammar

Collection of graphical primitives for composing data driven graphics

## Charting

Collection of fixed charts that require data to be shaped in a particular way

## Code

(imperative)

Describe how each interaction needs to be computed

**Pixel**

Paint directly on a canvas. Design & manage every pixel & interaction

**Visual**

GUI tools allowing flexibility to make interactions

**Grammar**

Collection of graphical primitives for composing data driven graphics

**Code**  
(imperative)

Describe how each interaction needs to be computed

**Charting**

Collection of fixed charts that require data to be shaped in a particular way

# Python Data-Viz Libraries



# Python Libraries

**Static e.g.**

matplotlib, seaborn, pandas

**Interactive e.g.:**

altair, bokeh, plotly, holoviews

# Rendering Capabilities

## Number of Data Points

- SVG:  $\sim 10^3$
- Canvas:  $\sim 10^4$
- Web.gl:  $\sim 10^6$

## **Exercise: Start with the small dataset**

- Getting started with Altair
- Let us use the sample dataset
- Please make at least 2 visualisation from the hand-drawn examples

# Case Introduction

- Context: Telco Churn Data
- Start with Why & What
- Dataset introduction



why

what

how

do what

so why

# **Exercise – Basic Visualisation**

## **Create simple static visualisations**

- 1D Continuous
- 1D Categorical
- 2D Continuous and Categorical
- 2D Continuous & Continuous
- 2D Categorical & Continuous

Chart Options

● Points

■ Bars

↗ Lines

█ Areas

1d Quantitative

1d Categorical

2d Quantitative +  
Categorical

2d Categorical +  
Categorical

2d Quantitative +  
Quantitative

## Chart Options

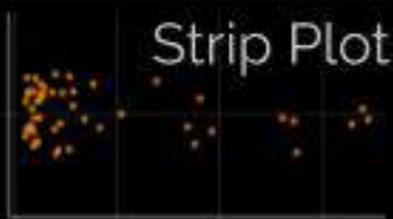
### Points

### Bars

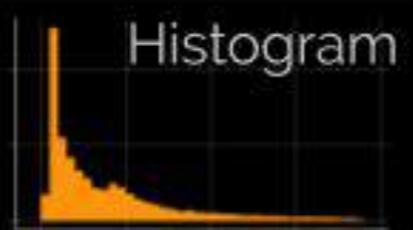
### Lines

### Areas

#### 1d Quantitative



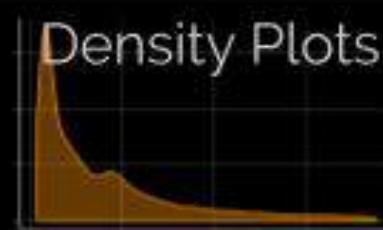
Strip Plot



Histogram

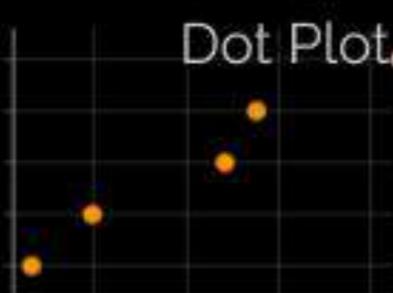


Freq Poly

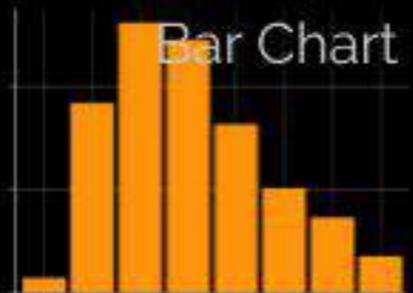


Density Plots

#### 1d Categorical



Dot Plot

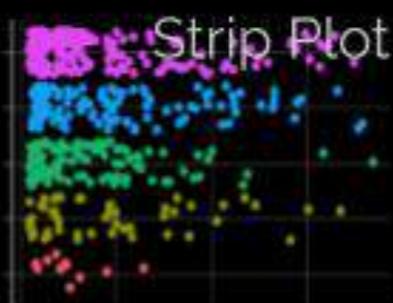


Bar Chart

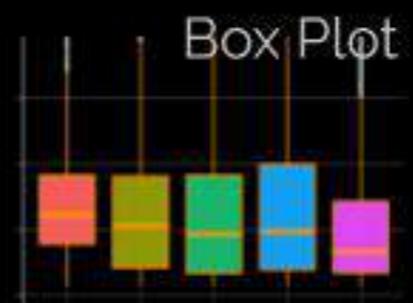
Avoid

Avoid

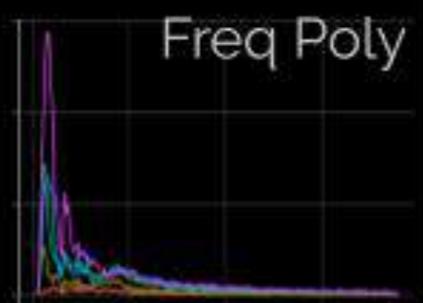
#### 2d Quantitative + Categorical



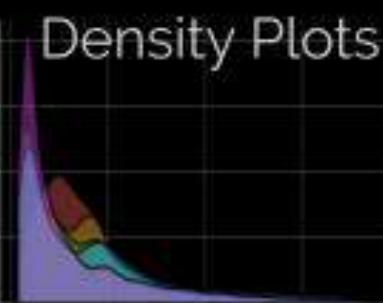
Strip Plot



Box Plot



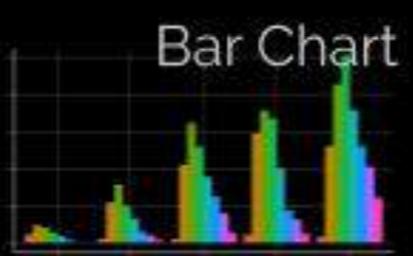
Freq Poly



Density Plots

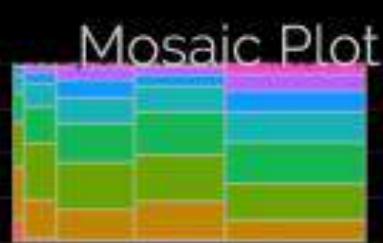
#### 2d Categorical + Categorical

Avoid



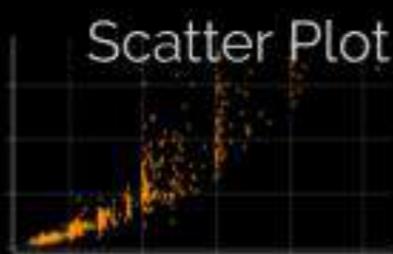
Bar Chart

Avoid



Mosaic Plot

#### 2d Quantitative + Quantitative



Scatter Plot



Table Lens



Slopegraph

Avoid

# Visualisation Guides

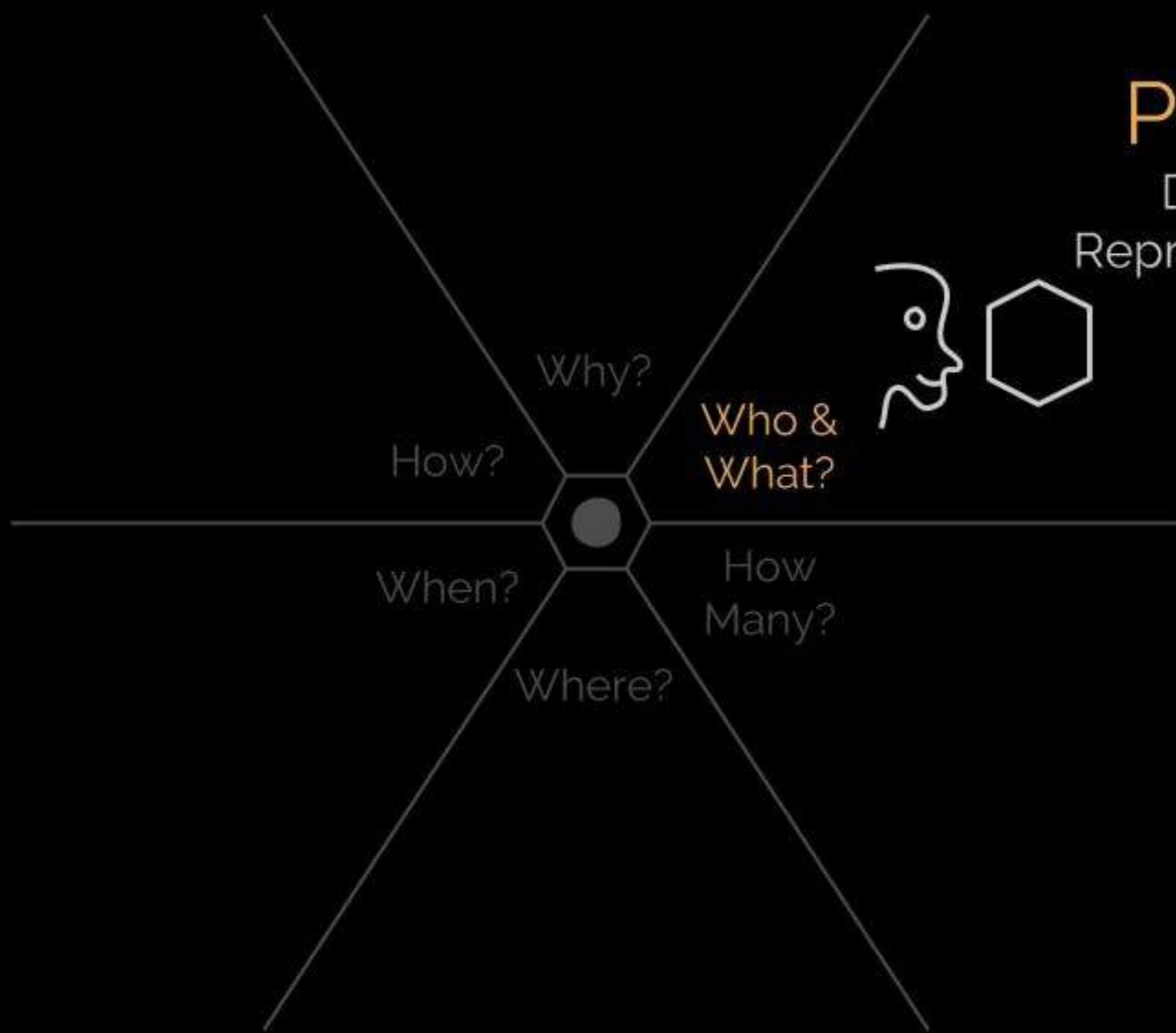
Visualization gives you **answers to questions  
you didn't know you had.**

— Ben Schneiderman



# Portrait

Distribution  
Representation



# Who & What: Distribution<sup>1</sup>

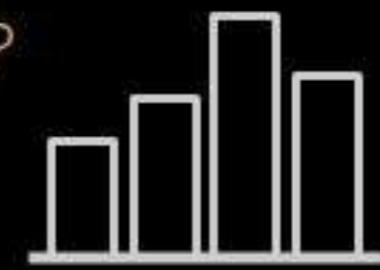


<sup>1</sup> Capabilities Premium

Portrait  
Distribution  
Representation



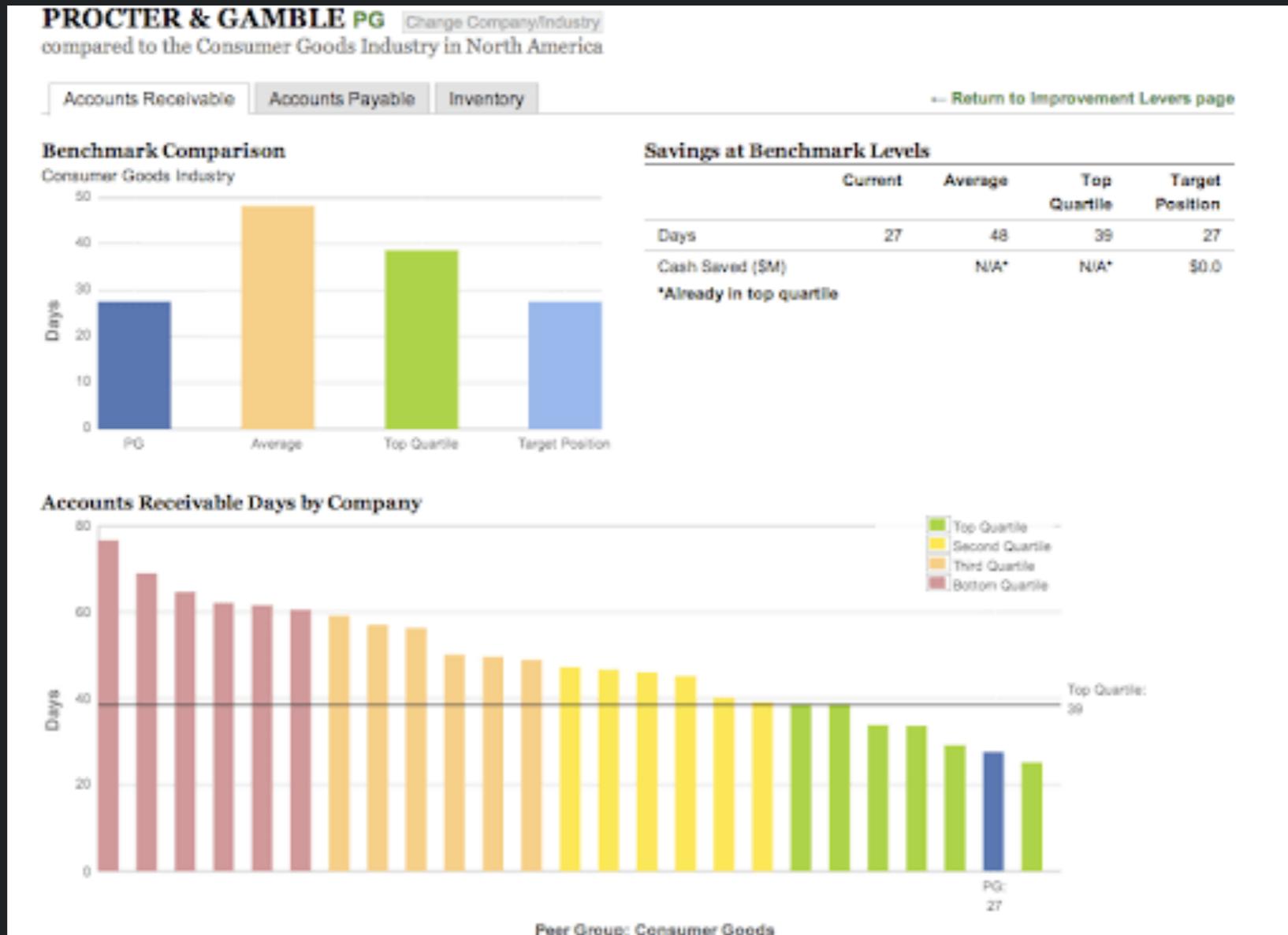
Why?  
How?  
Who &  
What?  
When?  
How  
Many?  
Where?



Comparison  
Comparative  
Representation



# How Many: Comparison<sup>2</sup>



<sup>2</sup> Working Capital Profiler

Portrait

Distribution

Representation



Comparison

Comparative

Representation

Map

Position in Space

?

★

⊗

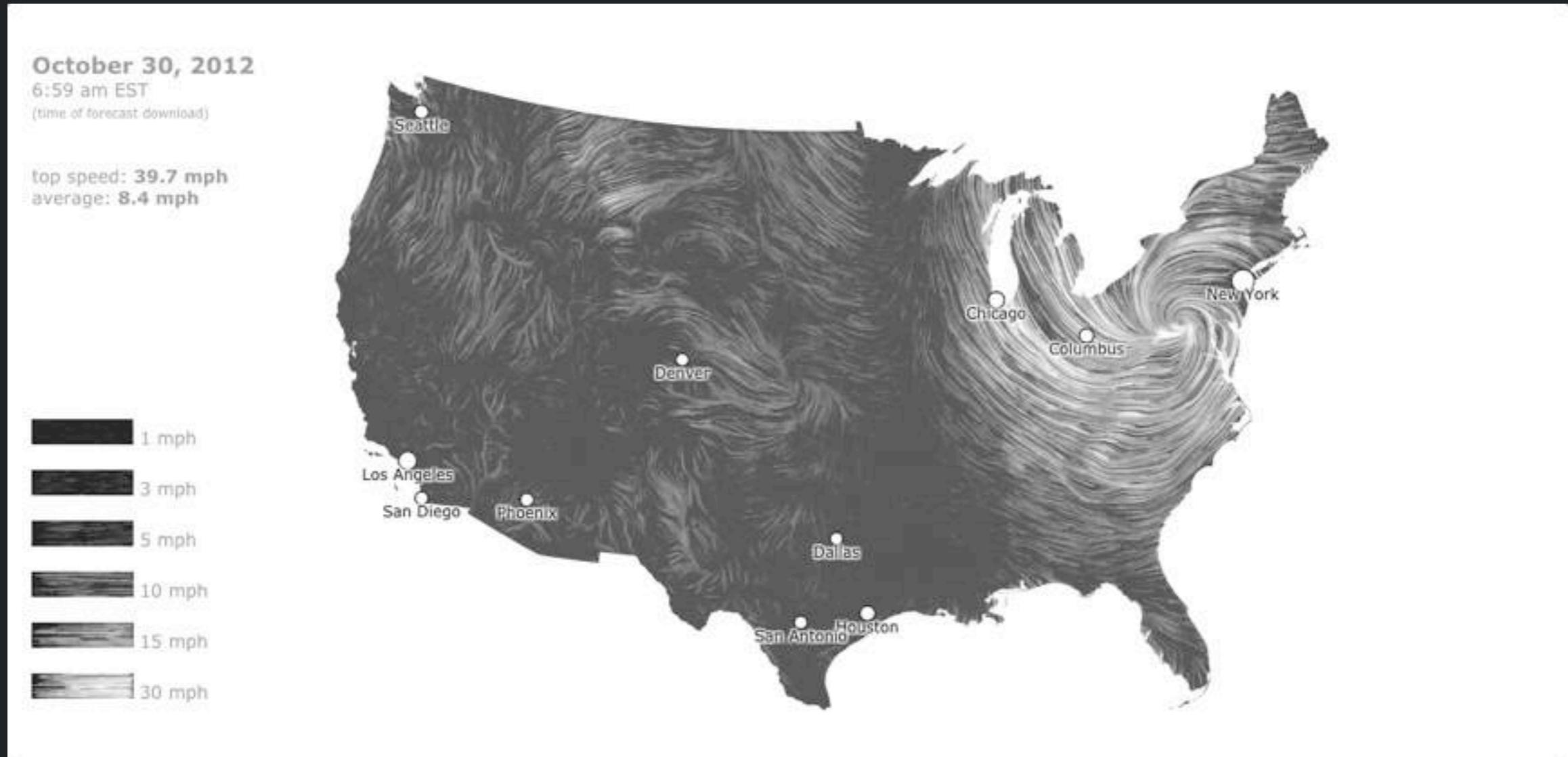
★

Why?  
How?  
Who &  
What?

When?  
Where?  
How  
Many?

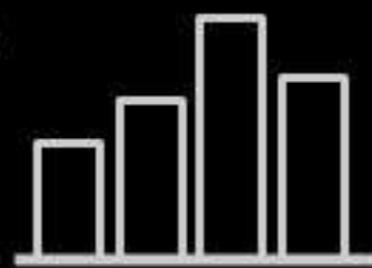
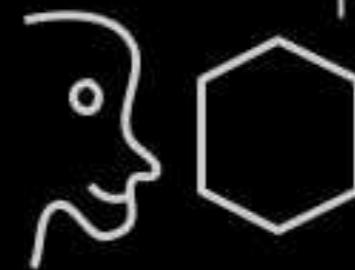
Position in Space

# Where: Maps<sup>3</sup>



<sup>3</sup> Wind Map

Portrait  
Distribution  
Representation



Timeline

Position in  
Time



Why?  
How?  
Who &  
What?

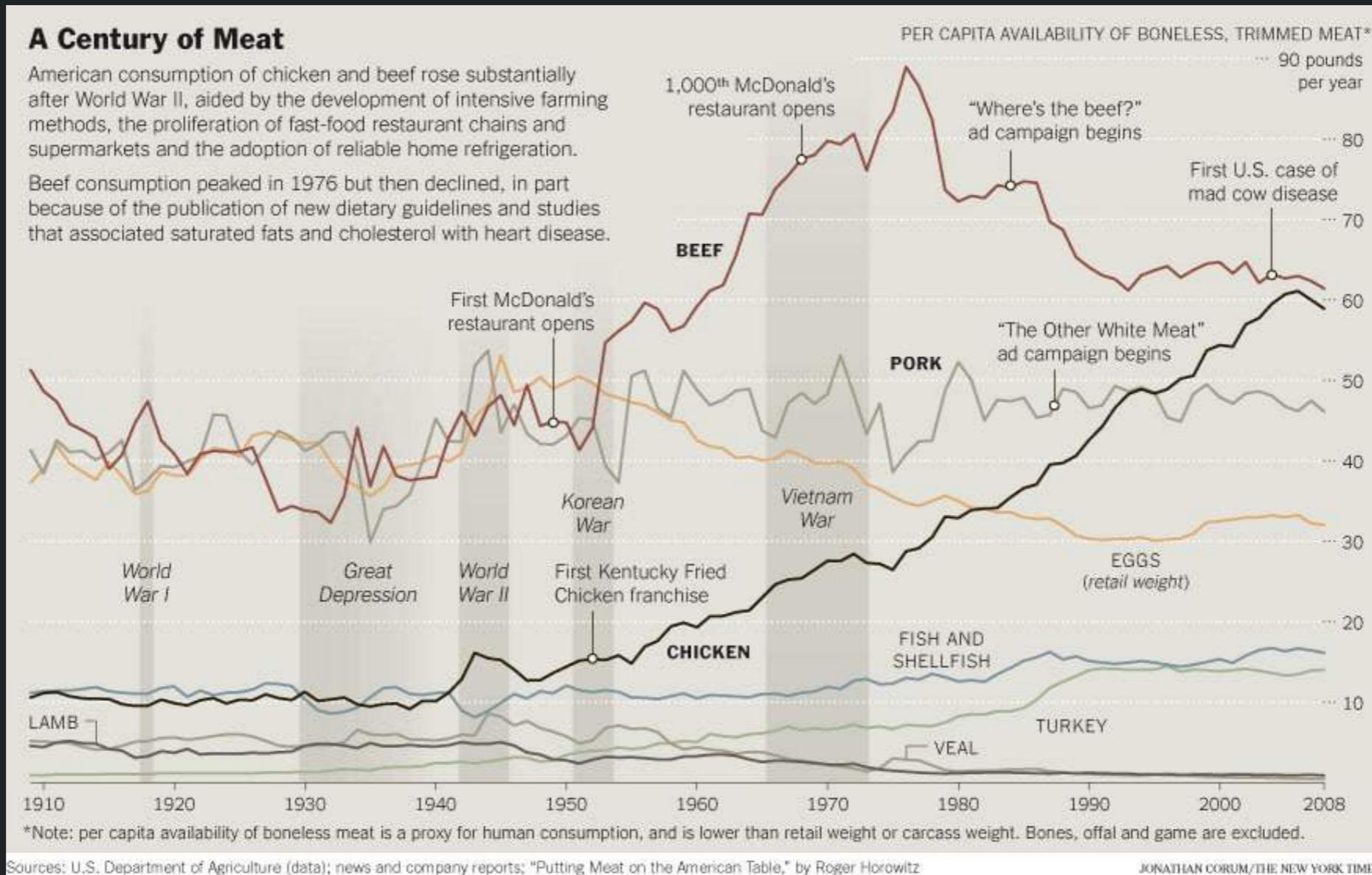
When?  
Where?  
How  
Many?



Map  
Position in Space

Comparison  
Comparative  
Representation

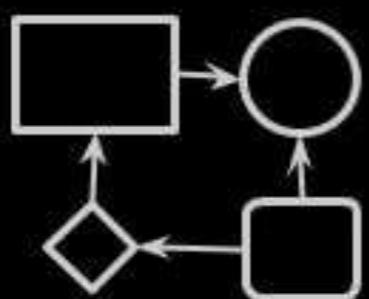
# When: Timeline<sup>4</sup>



<sup>4</sup> New York Times

# Flowchart

Relationship,  
Hierarchy



# Timeline

Position in  
Time



# Map

Position in Space



# Portrait

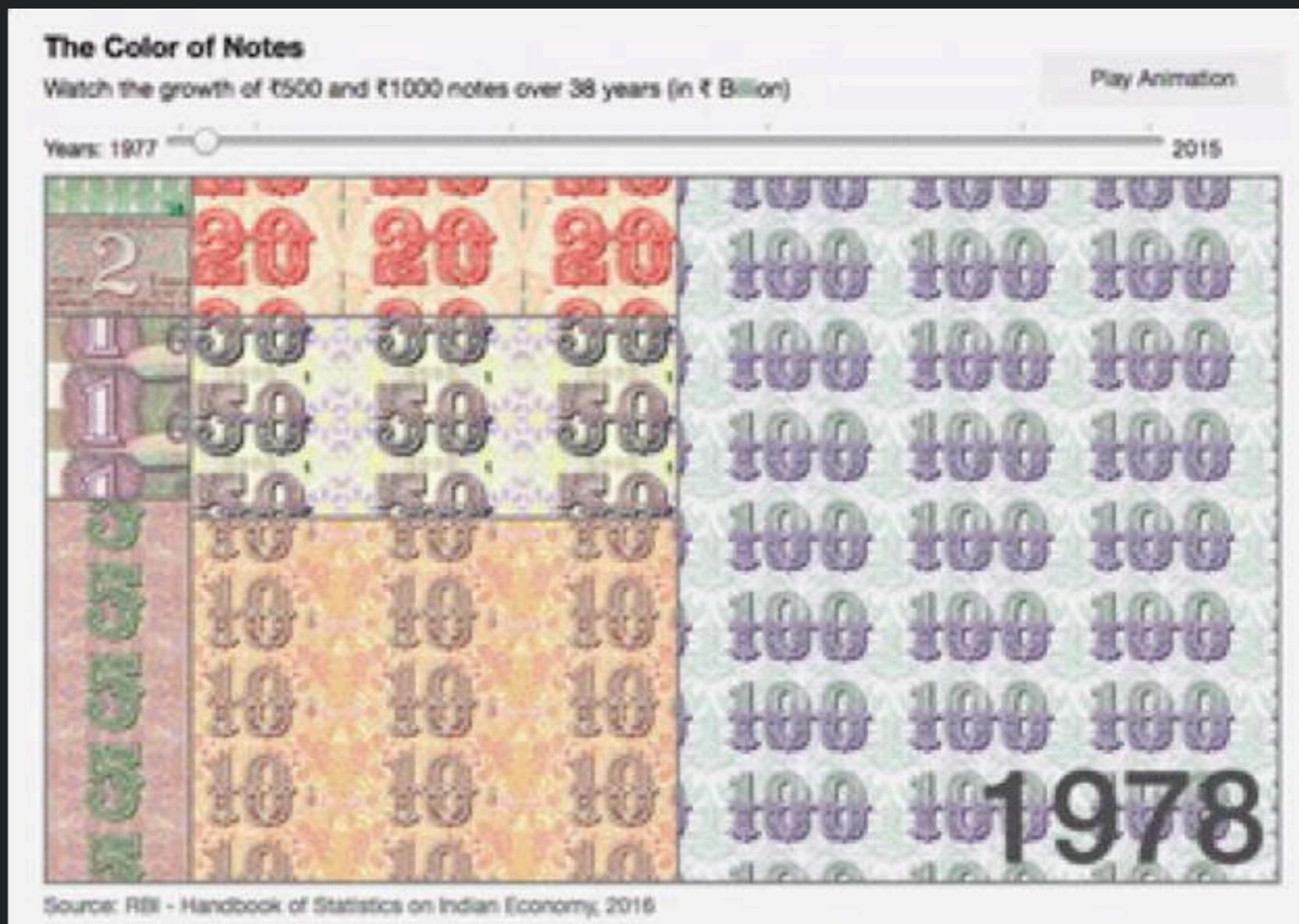
Distribution  
Representation



# Comparison

Comparative  
Representation

# How: Relationship<sup>5</sup>



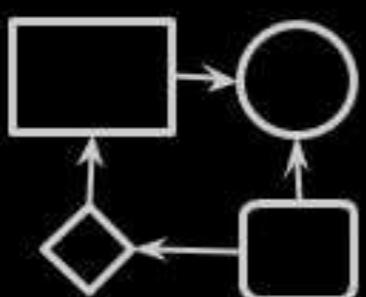
<sup>5</sup> Amit Kapoor

# Multi Variable

Deduction & Prediction

## Flowchart

Relationship,  
Hierarchy



## Timeline

Position in  
Time



Position in Space

## Map



## Portrait

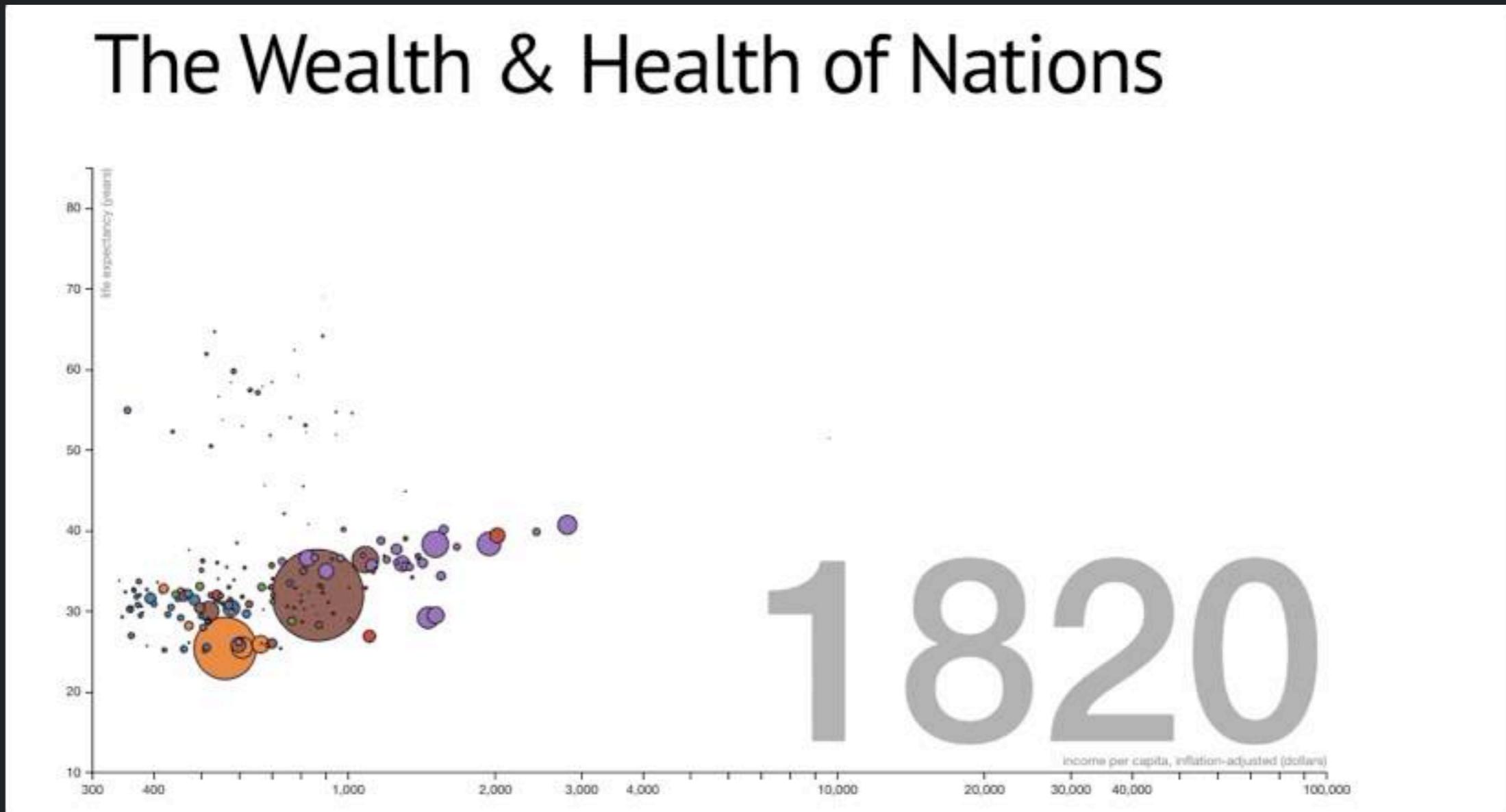
Distribution  
Representation



## Comparison

Comparative  
Representation

# Why: Deduction & Prediction<sup>6</sup>



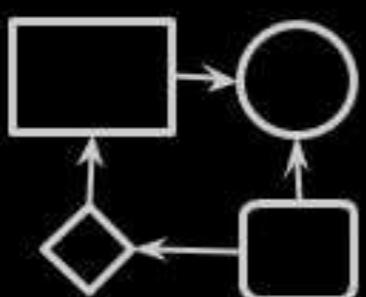
<sup>6</sup> Mike Bostock

# Multi Variable

Deduction & Prediction

## Flowchart

Relationship,  
Hierarchy



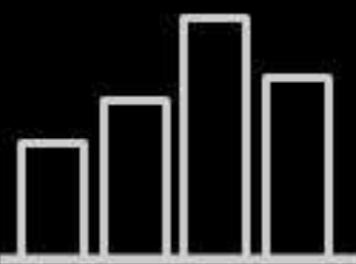
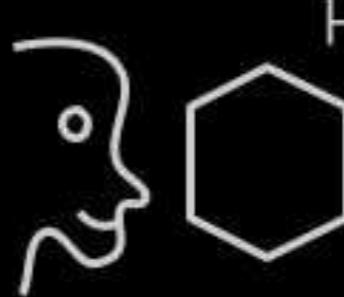
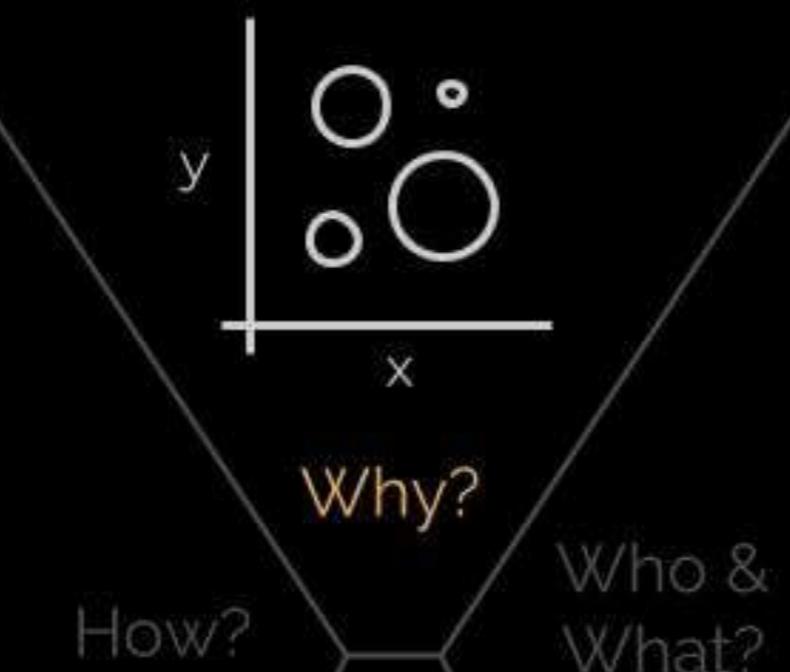
## Timeline

Position in  
Time



Position in Space

## Map



## Comparison

Comparative  
Representation

# **Guide to choosing appropriate visualisation**

**FT Visual Vocabulary**

[ft.com/vocabulary](https://ft.com/vocabulary)

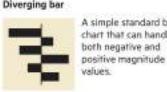
**Vega-lite version**

[gramener.github.io/visual-vocabulary-vega/](https://gramener.github.io/visual-vocabulary-vega/)

## Deviation

Emphasise variations (</>) from a fixed reference point. Typically the reference point is zero but it can also be a target or a long-term average. Can also be used to show sentiment (positive/neutral/negative).

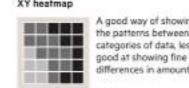
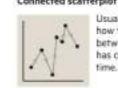
**Example FT uses**  
Trade surplus/deficit, climate change



## Correlation

Show the relationship between two or more variables. Be mindful that, unless you tell them otherwise, many readers will assume the relationships you show them to be causal (i.e. one causes the other).

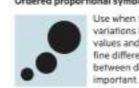
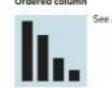
**Example FT uses**  
Inflation & unemployment, income & life expectancy



## Ranking

Use where an item's position in an ordered list is more important than its absolute or relative value. Don't be afraid to highlight the points of interest.

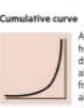
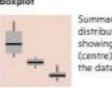
**Example FT uses**  
Wealth, deprivation, league tables, constituency election results



## Distribution

Show values in a dataset and how often they occur. The shape ('skew') of a distribution can be a reasonable way of highlighting the lack of uniformity or equality in the data.

**Example FT uses**  
Income distribution, population (age/sex distribution)



## Change over Time

Give emphasis to changing trends. These can be short (time-day) movements or extended series traversing decades or centuries. Choosing the correct time period is important to provide suitable context for the reader.

**Example FT uses**  
Share price movements, economic time series



## Magnitude

Show size comparisons. These can be relative (just being able to see larger/larger) or absolute (need to see fine differences). Usually these show a 'counted' number (for example, barrels, dollars or people) rather than a calculated rate or per cent.

**Example FT uses**  
Commodity production, market capitalisation



## Part-to-whole

Show how a single entity can be broken down into its component elements. If the reader's interest is solely in the size of the components, consider a magnitude-type chart instead.

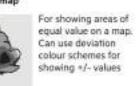
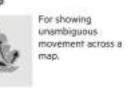
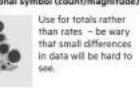
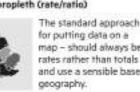
**Example FT uses**  
Fiscal budgets, company structures, national election results



## Spatial

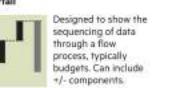
Above from locator maps only used when precise locations or geographical patterns in data are more important to the reader than anything else.

**Example FT uses**  
Population density, natural resource locations, natural disaster risk/impact, catchment areas, variation in election results



Show the reader volumes or intensity of movement between two or more states or conditions. These might be logical sequences or geographical locations.

**Example FT uses**  
Movement of funds, trade, migrants, lawsuits, information; relationship graphs.



# Visual vocabulary

## Designing with data

There are so many ways to visualise data - how do we know which one to pick? Use the categories across the top to decide which data relationship is most important in your story, then look at the different types of chart within the category to form some initial ideas about what might work best. This list is not meant to be exhaustive, nor a wizard, but is a useful starting point for making informative and meaningful data visualisations.

FT graphic: Alan Smith, Chris Campbell, Ian Bon, Liz Fauno, Graham Parry, Billy Ehrenberg, Paul McCullum, Martin State  
Inspired by the Graphic Continuum by Jon Schwabish and Trevor Risseka

## **Exercise - Purpose:**

**Creating visualisation with purpose & objective**

- Distribution
- Ranking
- Magnitude
- Correlation

# #3: Theory of Data Visualisation

"We do data visualisations  
to **learn** something new,  
not just to **confirm**"  
— Edward Tufte

# Encoding Grammar

## Deep dive into the grammar of graphics

- Data: wide tabular, long tabular
- Transform: bin, sort, filter, calculate, age
- Mark: symbol-type, length-type, area-type
- Channels: X, Y, size, colour, shape, text
- Scales: continuous, discrete, discretising
- Guides: axis, legends, labels
- Coordinates: cartesian, geographic

# Encoding

See **Representation Slide Deck** for more concepts

# **Exercise – Encoding**

Encode the telco churn data visualisation using different marks & channels

- Alternate mark representation
- Alternate channel choices

# Decoding Principles

Understand how visual perception works

- Gestalt & visual perception
- Ranking of channel effectiveness & efficiency

Apply to select appropriate visualisations

- Error in decoding & empirical evidence

# **Aesthetics**

See **Aesthetics Slide Deck** for more concepts

# **Exercise – Decoding**

Visualisation decoding critique and improving an existing visualisation

- Alternate transformation & representations
- Alternate scale representations

# #4: Guidelines for Better Data Visualisation

# Resources

See **Aesthetics Slide Deck** for more concepts

# **Concept – Enhancing Visualisation**

Guidelines for enhancing static data visualisation

- Comparing & sorting
- Add encoding variables
- Optimal scales & reference lines
- Layering & facets
- Over-plotting reduction

## **Exercise – Enhance**

Enhancing an existing static visualisation in python

- Adding facets & layers exercise
- Handling over-plotting reduction

# **Concept – Color & Guides**

Effective use of color & guides in data visualisations

- Chart junk & data-ink ratio
- Guidelines on axes and legends
- Color for categorical & continuous encoding
- Aesthetics & theming to have consistent style

# **Exercise – Redesign**

Redesign of an existing visualisation to improve guides, color & aesthetics

# **Narrative Group Exercise**

# Data-Story Exercise

## Building narrative with purpose & audience context

- To prepare a three-slide data-visual-story to be presented tomorrow morning.
- Presentation timing is 2 mins
- Groups to get started on the assignment

# Day One Summary

- Recap of day one concepts and lessons
- Set the context for day two sessions
- Questions & Answers on Day 1 scope

# Day 2 Sessions

- **Recap & Questions** (0930 - 0950)
- **Data-Story Presentations** (0950 - 1020)
- **Session #5: Crafting Visual Stories with Data** (1020 - 1120)
- Break (1120 - 1140)
- **Data-Story Rework** (1140 - 1210)
- **Session #6: Interactivity** (1210 - 1320)
- Lunch (1320 - 1420)
- **Session #7: Explorable Vis for Business Users** (1420 - 1540)
- Tea Break (1540 - 1600)
- **Session #8: Putting together an Interactive Application** (1600 - 1720)
- **Overall Summary & Way Forward** (1720 - 1800)