Data Visualization

Chapter(2)
Visual Representations

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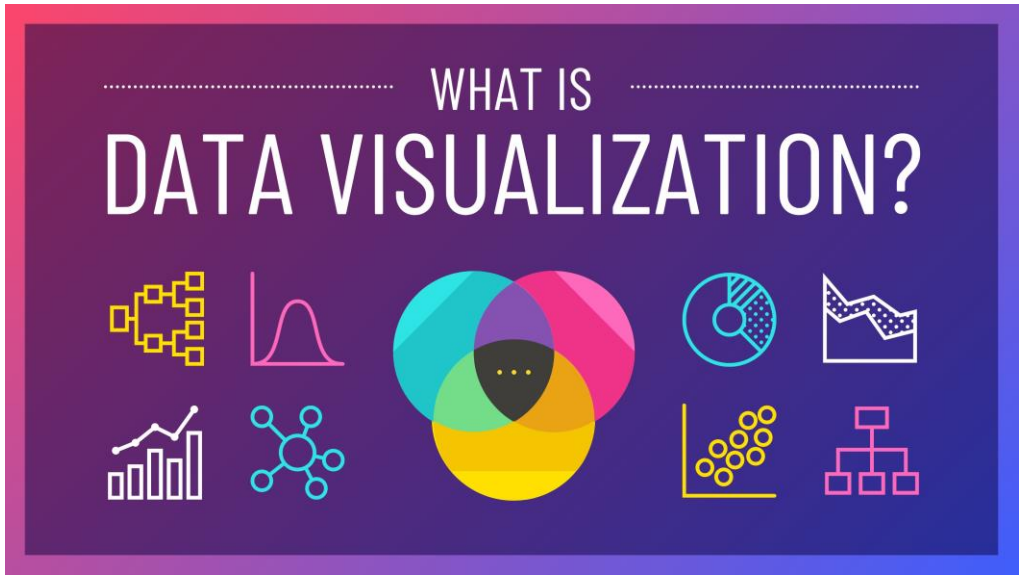
Overview

- **Visual Representations**
- Visualization reference model,
- Visual mapping
- Visual analytics
- Design of visualization applications.

Visual representations



- Words don't always paint the clearest picture. Raw data doesn't always tell the most compelling story.
- The human mind is very receptive to visual information. That's why data visualization is a powerful tool for communication.
- But if "data visualization" **sounds tricky** and **technica**l don't worry—it doesn't have to be.
- Explain the fundamentals of data visualization in a way that anyone can understand.
- Included are a ton of examples of different types of data visualizations and when to use them for your reports, presentations, marketing, and more.

Visual representations

- Visual representations are graphical depictions of data used in data visualization.
- They provide an intuitive way to explore and communicate information, making it easier for viewers to understand complex concepts and patterns.
- Data visualizations often use elements of visual storytelling to communicate a message supported by the data.
- **Data visualization can be used for:**
  - Making data engaging and easily digestible
  - Identifying trends and outliers within a set of data
  - Telling a story found within the data
  - Reinforcing an argument or opinion
  - Highlighting the important parts of a set of data

Visual representations

. Here are some examples of visual representations commonly used in data visualization:

- Bar charts are used to compare the frequency, value, or distribution of a set of data. They consist of horizontal or vertical bars that represent the data values. The length or height of each bar is proportional to the value it represents.

  Example: A bar chart can be used to compare the sales of different products in a given period. Each bar represents a product, and the height of the bar represents the sales volume.

- Line Charts: Line charts are used to represent the trend of a variable over time. They consist of a series of data points connected by a line, which represents the change in value over time.

  Example: A line chart can be used to track the growth of a company's revenue over time. Each data point represents the revenue in a given period, and the line connects the points to show the trend.

- Scatter Plots: Scatter plots are used to visualize the relationship between two variables. They consist of a set of data points, where each point represents a pair of values for the two variables.

  Example: A scatter plot can be used to explore the relationship between a company's revenue and its marketing spend. Each data point represents a combination of revenue and marketing spend, and the position of the point on the plot shows the relationship between the two variables.

Visual representations

- Heat Maps: Heat maps are used to represent the distribution of values in a matrix or table. They use color coding to represent the magnitude of the values, with darker colors indicating higher values.

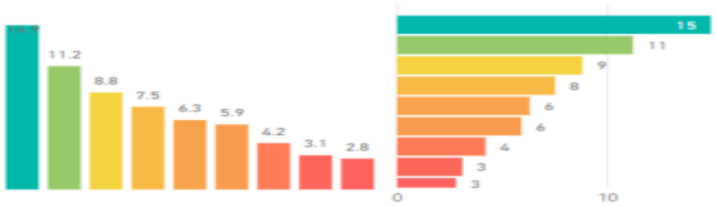
  Example: A heat map can be used to show the distribution of web traffic across different regions. The table of traffic data is represented as a grid of cells, where the color of each cell represents the volume of traffic from that region.

- Tree Maps: Tree maps are used to represent hierarchical data structures, such as file systems or organizational charts. They use nested rectangles to represent the hierarchy of data.

  Example: A tree map can be used to visualize the file system of a computer. Each folder is represented as a rectangle, and the size of the rectangle represents the size of the folder. Subfolders are nested within the rectangles of their parent folders, creating a hierarchical structure.

Visual representations

CHART TYPES IN A NUTSHELL

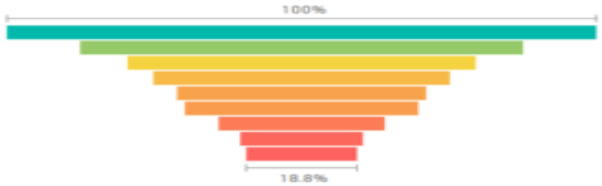


HISTOGRAM/ STACKED COLUMN OR BAR CHART

Chart used by analysts who understand the power of segmentation and the sadness that comes from aggregation data.

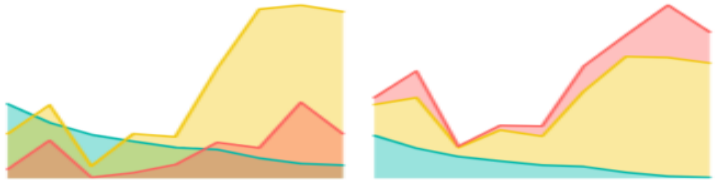
DONUT AND PIE CHART

Extremely useful when creating a well designed document that is intended to people that will not read the data. But should't be used if the elements are too many (i.e. more than 15), because it won't be useful anymore.



FUNNEL CHART

It is used to visualize the progressive reduction of data as it passes from one phase to another. Very useful if used to represent stages in a sales process and show the amount of potential revenue for each stage.



AREA and STACKED AREA CHART

Use a stacked area chart for multiple data series with part-to-whole relationships or for cumulative series of value. But personally, I always try to avoid this type of chart

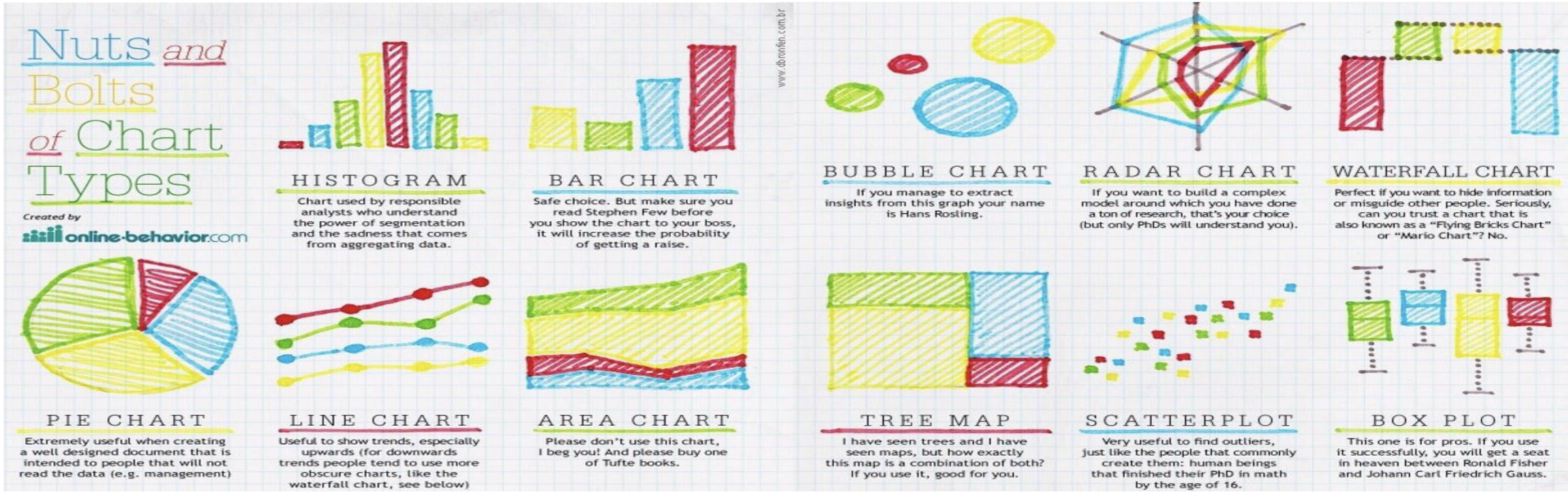
LINE CHART

A line chart is often used to visualize a trend in data over intervals of time. If you have continuous data that you would like to represent through a chart then a line chart is a good option.

TREEMAP CHART

Treemapping is a data visualization technique that is used to display hierarchical data using nested rectangles.The treemap chart displays categories by color and proximity and can easily show lots of data which would be difficult with other chart types.

Visual representations



Visualization Reference Model:

The visualization reference model is a framework that describes the various stages involved in creating a visual representation of data.

It provides a structured approach for transforming raw data into insightful visualizations that can be easily understood and interpreted.

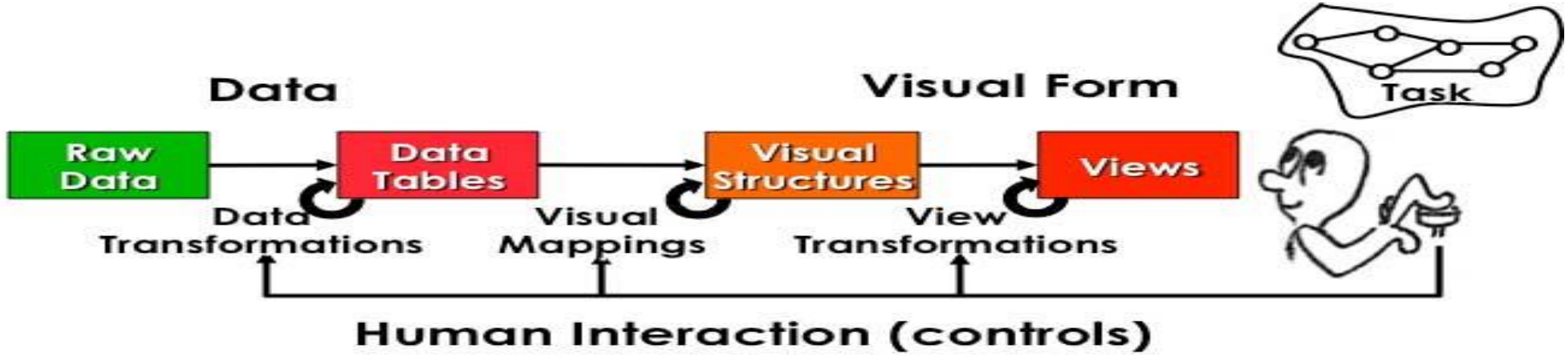
- Example: A weather forecasting company collects data from various sources to predict weather patterns. The data is cleaned and transformed into a format suitable for visualization, and visual mapping is used to map the data to visual elements such as a map or a graph. Finally, the visualization is rendered for analysis.

Visualization Reference Model:

It consists of four main stages:

1. Data acquisition: This stage involves collecting and preparing the data that will be used for visualization. It can include tasks such as data cleaning, filtering, and formatting to make the data suitable for visualization.
    - Example: A marketing company wants to create a visualization that shows the sales performance of a new product. The data acquisition stage would involve collecting sales data from various sources, cleaning and filtering the data to remove any errors or outliers, and formatting the data in a way that is suitable for visualization.
2. Data transformation: In this stage, the data is transformed into a format that can be easily visualized. This can involve tasks such as aggregating data, summarizing data, or filtering data.
    - Example: In the marketing company's project, the data transformation stage might involve summarizing the sales data by region, product, or time period, depending on the needs of the visualization.
3. Visual mapping: This stage involves mapping the data to visual elements such as colors, shapes, and sizes. This helps to make the data more understandable and interpretable.
    - Example: For the marketing company's visualization, the visual mapping stage might involve using colors to represent different product lines or regions, and using different shapes or sizes to represent sales volume or profitability.
4. Visualization rendering: This is the final stage where the visualization is created and rendered for analysis. This can involve choosing the appropriate visualization tools or software, and creating the visualizations themselves.
    - Example: In the marketing company's project, the visualization rendering stage might involve using software tools such as Tableau or Power BI to create interactive dashboards or reports that can be used to explore and analyze the sales data.

Visualization Reference Model:



Raw Data:	- idiosyncratic formats
Data Tables:	- relations (cases by variables) + meta-data
Visual Structures:	- spatial substrates + marks + graphical properties
Views:	- graphical parameters (position, scaling, clipping, ...)

Visual Mapping

- Visual mapping is the process of mapping data to visual elements such as color, shape, and size. It is an essential step in creating effective visualizations that can be easily understood by users.
- The choice of visual mapping can influence how the data is interpreted by the viewer.
  - Example: A chart that shows the growth of a company can use a color-coded line to represent the different product lines. This visual mapping can help the viewer quickly identify which product lines are growing and which ones are declining.

Visual Mapping

There are several techniques of visual mapping, including the following:

1. Color mapping: In this technique, different colors are assigned to different data categories or values. For example, a bar chart representing sales data by region might use different colors to represent each region.
2. Shape mapping: In this technique, different shapes are assigned to different data categories or values. For example, a scatter plot representing the relationship between two variables might use different shapes to represent different data points.
3. Size mapping: In this technique, different sizes are assigned to different data categories or values. For example, a bubble chart representing sales data by product might use different bubble sizes to represent different product categories.
4. Texture mapping: In this technique, different textures are assigned to different data categories or values. For example, a map representing population density might use different textures to represent different levels of population density.

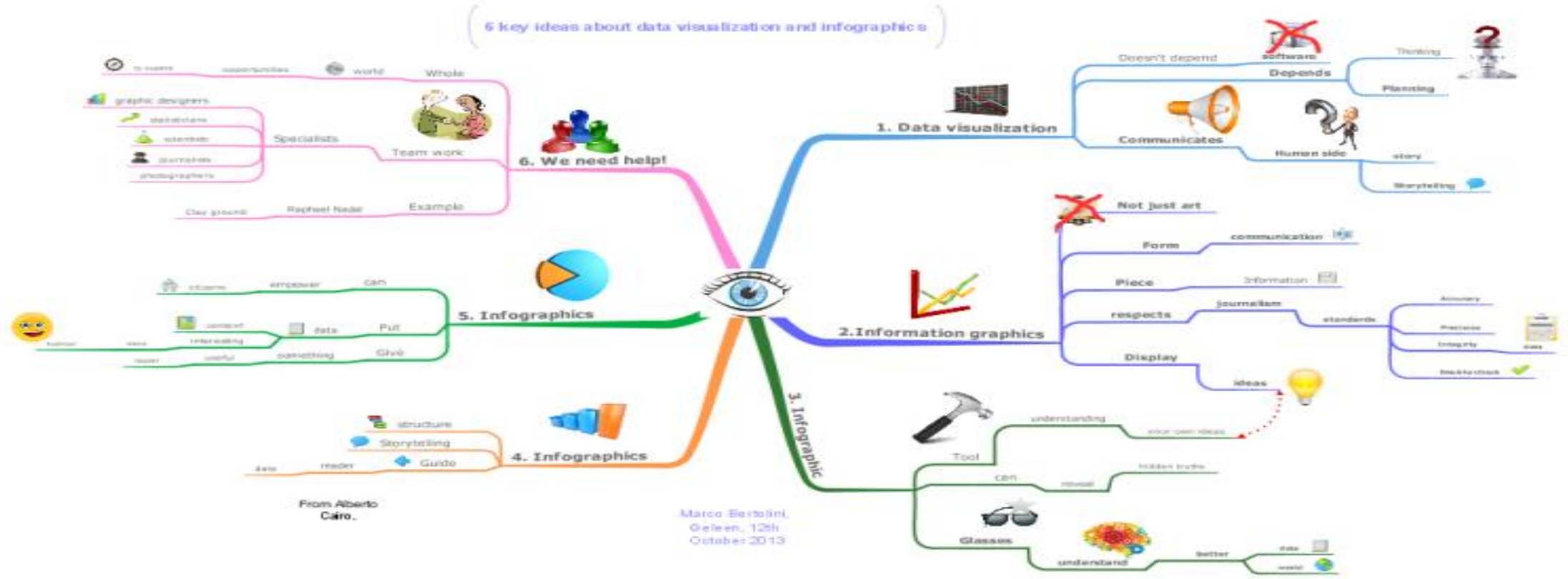
Visual Mapping

Here are some examples of visual mapping in data visualization:

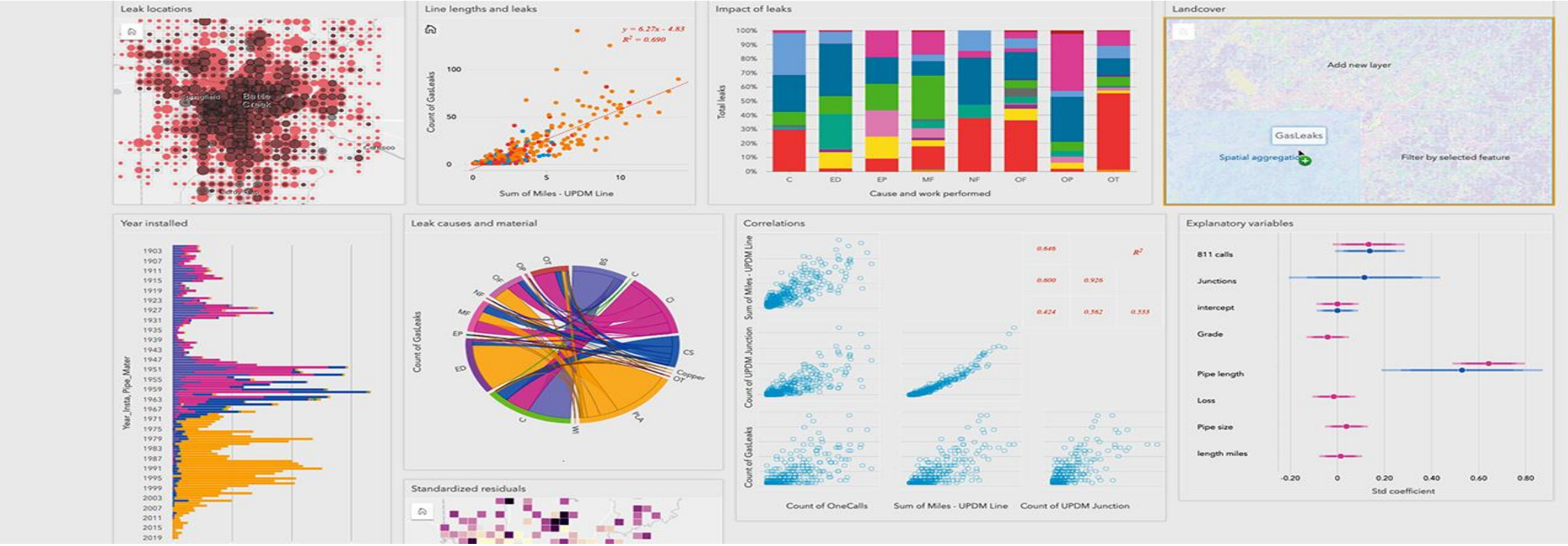
1. Heat maps: In a heat map, colors are used to represent the intensity of values. For example, a heat map representing website traffic might use shades of red to represent high traffic areas and shades of green to represent low traffic areas.
2. Bubble charts: In a bubble chart, the size of bubbles is used to represent values. For example, a bubble chart representing stock prices might use the size of bubbles to represent market capitalization.
3. Choropleth maps: In a choropleth map, colors are used to represent values for different geographic regions. For example, a choropleth map representing unemployment rates might use different colors to represent different levels of unemployment across different states.
4. Scatter plots: In a scatter plot, the position of data points represents values for two variables. For example, a scatter plot representing the relationship between height and weight might use the position of data points to represent the height and weight of individuals.

Overall, visual mapping is a crucial technique in data visualization that helps to transform raw data into meaningful visual representations. By using appropriate visual mapping techniques, data analysts and visualization experts can create visualizations that are accurate, understandable, and insightful, helping decision-makers to make better-informed decisions based on data.

Visual Mapping



Visual Mapping



Visual analytics

- Visual analytics is the process of using visual representations to analyze and understand data.
- It involves combining visualization techniques with analytical methods to gain insights and make decisions based on data.
- Example: A stock market trader uses visual analytics to analyze stock prices over time. The trader may use a candlestick chart to visualize the price movements and identify trends. They can then use analytical methods to identify patterns and make informed decisions on buying or selling stocks

Visual analytics

Visual analytics

- Visual analytics is a process of using interactive visualizations and analytical tools to explore, analyze, and understand complex data sets.
- It combines data analysis and visualization techniques to enable users to gain insights and make decisions based on data.
- The goal of visual analytics is to empower users to uncover patterns, trends, and relationships that might not be apparent through traditional data analysis methods.
- Visual analytics involves several steps, including data preparation, data exploration, data analysis, and decision-making. Here are the key steps involved in the process:

1. Data preparation: In this step, data is collected, cleaned, and transformed into a format that can be used for analysis. This may involve tasks such as data cleaning, data normalization, and data integration.
2. Data exploration: In this step, data is visualized using interactive visualizations such as scatter plots, heat maps, and bar charts. The user can explore the data by interacting with the visualizations and identifying patterns and trends.
3. Data analysis: In this step, the user applies analytical techniques such as statistical analysis, machine learning, and data mining to the data to uncover deeper insights.
4. Decision-making: In this step, the user makes decisions based on the insights gained from the data analysis. The user can use the insights to identify opportunities, mitigate risks, or optimize processes.

Visual analytics

- Here are some examples of visual analytics in action:
  1. Business intelligence: Visual analytics tools can be used to analyze sales data, customer data, and other business metrics to gain insights into business performance and identify opportunities for growth.
  2. Healthcare: Visual analytics tools can be used to analyze patient data, clinical data, and medical imaging data to identify patterns and trends in patient health and optimize treatment plans.
  3. Finance: Visual analytics tools can be used to analyze financial data, such as stock prices, market trends, and trading volumes, to identify investment opportunities and make informed investment decisions.
  4. Social media analysis: Visual analytics tools can be used to analyze social media data, such as user behavior, sentiment analysis, and engagement metrics, to gain insights into user preferences and optimize social media marketing campaigns.
- Overall, visual analytics is a powerful tool for gaining insights and making decisions based on data.
- By using interactive visualizations and analytical tools, users can explore and analyze complex data sets, uncover patterns and trends, and make informed decisions based on data.

Design of visualization applications.

- The design of visualization applications involves creating user interfaces that enable users to interact with and explore data through visualizations.
- The goal of designing visualization applications is to make the process of exploring and analyzing data as easy and intuitive as possible.
- A well-designed visualization application should provide users with clear and informative visualizations, as well as tools to explore and manipulate the data.
  - Example: A healthcare application may use visualization to represent patient data. The design should consider the needs of medical professionals who need to quickly identify trends and make informed decisions based on the data. The visualization should be clear and concise, with the ability to drill down into specific patient data for further analysis. The application should also be easy to use, with intuitive controls and navigation.

Design of visualization applications.

- Here are some key considerations in the design of visualization applications:

1. Data preparation and loading: The application should make it easy to load and prepare data for visualization. This might include features such as data cleaning, normalization, and filtering.
2. Visualization options: The application should provide a range of visualization options, including charts, graphs, maps, and other visualizations. Each visualization should be designed to effectively communicate the data being presented.
3. Interactivity: The application should provide interactive tools that enable users to explore and manipulate the data. This might include features such as zooming, panning, filtering, and sorting.
4. Customization: The application should allow users to customize the visualizations and data displays to suit their needs. This might include options for changing colors, fonts, and other visual elements.
5. Collaboration: The application should enable users to collaborate and share their visualizations with others. This might include features such as shared dashboards, commenting, and sharing options.

Design of visualization applications.

- Here are some examples of visualization applications:
  1. Tableau: Tableau is a popular visualization application that provides a range of interactive visualization options. Users can drag and drop data onto the interface to create custom visualizations and dashboards. Tableau also includes a range of data analysis tools, such as data blending and forecasting.
  2. Power BI: Power BI is a business analytics service that provides a range of visualization options and tools for exploring and analyzing data. Users can create custom dashboards and reports, and share them with others.
  3. D3.js: D3.js is a JavaScript library for creating custom visualizations and interactive data displays. D3.js provides a range of visualization options, and enables users to customize the visualizations using code.
  4. Google Data Studio: Google Data Studio is a free visualization application that enables users to create custom reports and dashboards using data from a range of sources. Users can share their visualizations with others, and collaborate in real-time.
- Overall, the design of visualization applications plays a crucial role in enabling users to explore and analyze data. By providing a range of visualization options, interactive tools, and customization options, visualization applications can empower users to gain insights and make informed decisions based on data.