

DATA

VISUALIZATION

→ Assignment

9/10

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① Explain how human Perceptual Processing models and Gestalt Principles influence the effectiveness of data visualization. Discuss with suitable examples how visualization designers can minimize information overload and maximize information clarity using concepts such as Gibson's Affordance theory, data abstraction, and appropriate dataset representation.

Introduction:-

Data visualization is one of the most powerful tools in modern communication because it transforms raw data into meaningful interpretable patterns. Its effectiveness depends on how well it aligns with human perception and cognition.

By applying Perceptual Principles like Gestalt Principles, and concepts like Gibson's Affordance theory, data abstraction, and proper dataset representation,

Human Perceptual Processing models in visualization.

Human Perceptual models explain how people quickly interpret visual data by recognizing patterns, colors, shapes and contrasts faster than text.

*Pre-attentive Processing:-

The brain instantly notices features like color, size, or orientation.

*Working memory limits:-

Since, human can only process few chunks of information at once visualization should summarize data.

Gesalt Principles and Data Visualization!

Gesalt Psychology explains how humans naturally see and grouping. These principles are essential in visual design because they help determine how users interpret graphs, charts.

i) Proximity:-

Elements that are close together are perceived as belonging to the same group.

ii) Similarity:-

objects with similar shapes, color or sizes are seen as part of the same category.

iii) Closure:-

Humans tend to fill in gaps to perceive a complete shape.

iv) Figure-Ground:-

People distinguish between foreground and background. Designers use this by ensuring important data stands out from gridlines or background elements, minimizing information overload and maximizing clarity.

1. Gibson's Affordance Theory:-

Gibson's Affordance Theory suggests that objects have inherent properties that indicate their possible uses. In visualization, this translates to intuitive design where the user instantly understands how to interact with or interpret the chart.

2. Data Abstraction:-

Raw data is often too large and complex for direct visualization. Data abstraction helps by reducing complexity while preserving meaning.

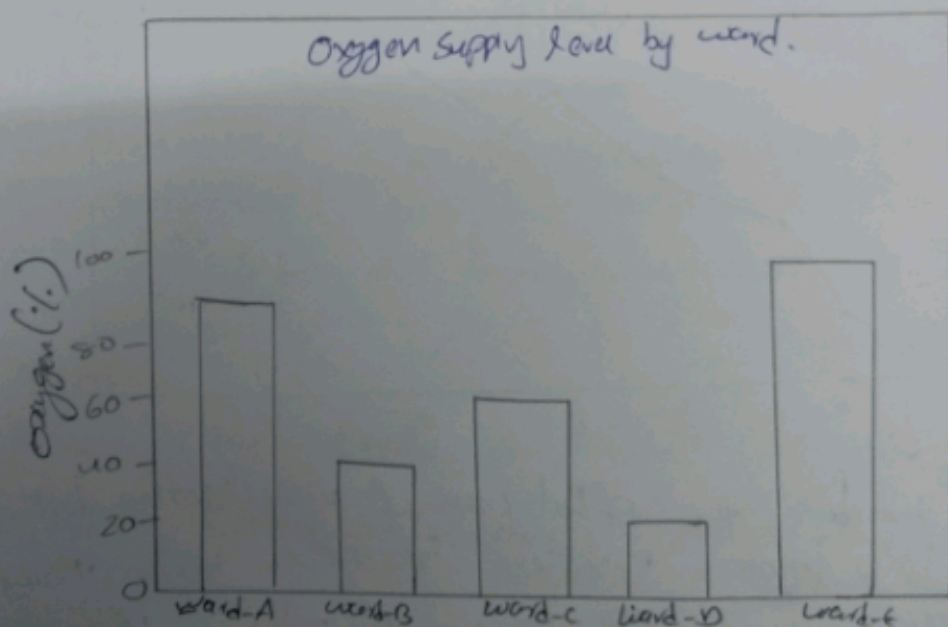
3. Appropriate Dataset Representation:-

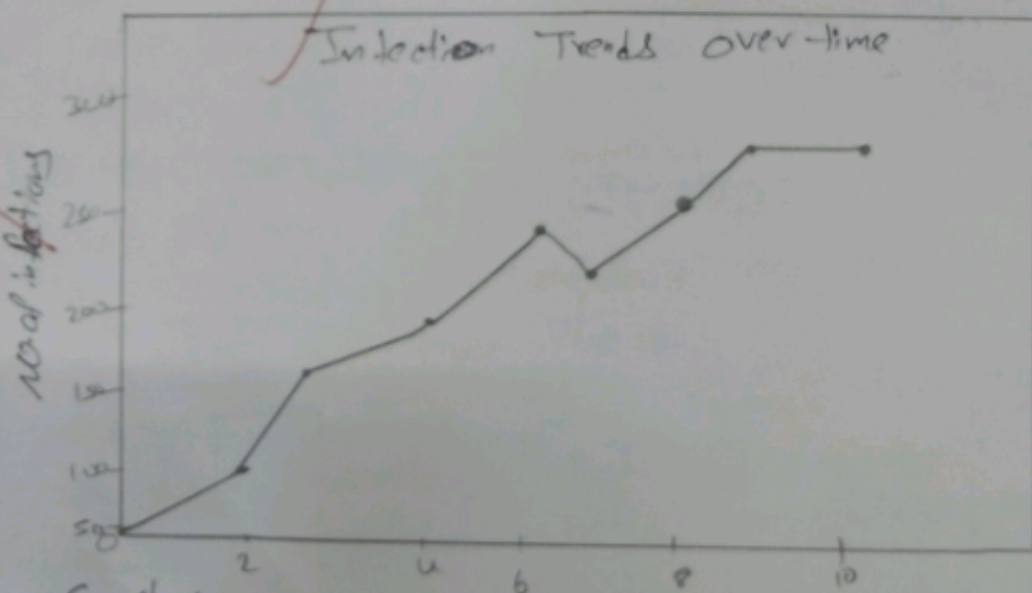
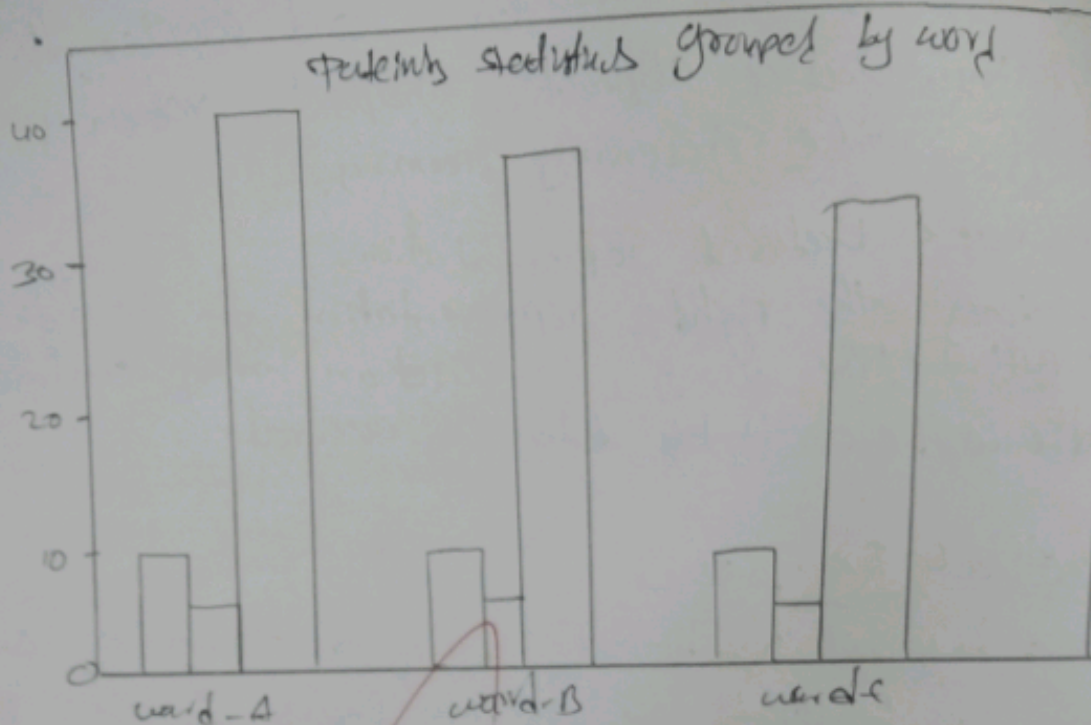
Choosing the right representation for the dataset is crucial. The wrong visualization may confuse the audience, even if the data is accurate.

Practical Examples:

In a hospital dashboard during a Pandemic, using color to highlight low oxygen levels grouping data by ward, adding interactive filters and choice of view visually helps doctor quickly interpret data.

* Bar chart





Conclusion:

Therefore, the effectiveness of visualization depends on how human perceive information, using Perceptual models, Gestalt Principles, affordance theory.

② With the help of suitable datasets, compare and contrast different visualization techniques used in univariate, Bivariate, and multivariate analysis. Explain how the choice of visualization depends on the type of data and the number of variables being analyzed. Provide at least one practical example for each analysis type.

Introduction:-

Data analysis is often categorized into univariate, Bivariate, and multivariate analysis depending on the number of variables studied. Visualization plays a vital role in each type of analysis because it helps in identifying patterns, relationships and anomalies.

* Univariate Analysis:-

univariate analysis involves analyzing a single variable at a time to understand its distribution, central tendency, and spread.

Suitable visualization Techniques:-

* Bar chart:- used when the variable is categorical

* Pie chart:- used when the variable is partitioned into the form of sectors.

Examples:-

1) Indian Census (male and female categorized by bar chart)

2) monthly Expenditure (Pie chart) (variables: food, saving).

Bivariate Analysis:

Bivariate Analysis deals with the relationship between two variables.

Suitable Visualization Techniques:-

- i) Scatter Plot with Fit line: used for two continuous variables.
- ii) Side by Side Box Plot
used if one variable is categorical and the other is continuous.
- iii) Grouped Bar chart:
used for two continuous variables.

Examples:

Consider a dataset of students' study hours and exam score.

A scatterplot with a regression line can reveal whether more study hours lead to higher marks.

Multivariate Analysis:-

Multivariate Analysis involves three or more variables simultaneously to uncover complex relationships.

Suitable Visualization Techniques:-

* Heat maps:

used for showing correlation matrices among multiple continuous variables.

Relationship
b/w
Pair Plot:-

Bubble chart:-

similar to a scatterplot but with a third variable represented by bubble size or color.

Pair Plot:-

Displays scatterplot for all Pairs of variables in a data set.



Conclusion:-

Therefore, ~~univariate~~, Bivariate and multivariate visualization serve different purposes distribution relationships and complex interaction. choosing the right chart type based on data type and helps raw data into insights, supporting better decisions.