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VTU21908

10211CS - Data
visualization

Slot: 34L6

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ASSIGNMENT : U1 & U2

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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 info. clarity using concepts such as Gibson's Affordance, data abstraction, and appropriate data representation.

ii) Human perceptual processing Models and Gestalt Principles in visualization

→ it is selective, pattern-oriented, and shaped by cognitive limits. Visualization designers leverage these perceptual tendencies to create visuals that are immediately interpretable.

~ Perceptual processing models.

- Pre-attentive processing: our brains can instantly detect differences in color, shape, size, orientation & spatial grouping without conscious effort

~ Gestalt principles

- Proximity: items close together are perceived as belonging together.
- Similarity: similar color/shapes are seen as part of the same group
- Continuity: our brains follow lines and curves smoothly
- Closure: we fill in missing parts to see complete forms.

(iii) Minimizing information overload and maximizing clarity

To avoid overwhelming users, visualization designer rely on psychological theories and abstraction strategies

~ Gibson's Affordance Theory

- Affordance describes what actions a design invites the user to take
- A slider invites filtering time-series data.
- Zoom/pan affordance suggest data exploration

~ Data Abstraction

- Not all raw data should be shown; abstraction removes unnecessary details while keeping the essence.

~ Appropriate dataset representation.

- Choosing the right visualization type is crucial:

Bar chart - categorical
Line chart - trends over time
Scatter plot - relationships
Heat map - density.

+ Examples:

~ Dashboards:

- Apply data abstraction by showing KPIs at the top with raw details hidden in secondary views

~ Scientific visualization:

- Climate change data → shows line trends with color similarity for regions.

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 no. of variables being analysed. Provide at least one practical example for each analysis type.

* Univariate Analysis:

- Understand distribution, frequency or spread of one variable
- Visualization techniques
 - Bar chart
 - Histogram
 - boxplot
- Data type consideration
 - categorical → Bar / pie chart
 - continuous → Histogram, violin plot

Example :- Analysis exam score of 100 students

* Bivariate Analysis:

- Explore relationships between two variables
- Visualization techniques
 - categorical vs. categorical: clustered / stacked bar chart
 - categorical vs. continuous: Boxplot, violin plot
 - continuous vs. continuous: scatterplot with fit line.
- Example: Relation between study hrs and exam results.

* Multivariate Analysis:

- understand complex relationships among multiple variable simultaneously.
- Visualization techniques:
 - heat maps - multiple continuous variable
 - stacked / Grouped Bar - multiple categorical comparisons
- Data type considerations:
 - works best with continuous variable when studying correlations.
 - For mixed data types, choose heatmap vs stacked bars.

Eg: customer dataset with age, income and spending score