

Tribhuvan University  
Institute of Sciences and Technology  
**SCHOOL OF MATHEMATICAL SCIENCES**  
First Assessment 2080

Subject: Data Visualization  
Course No. MDS 651  
Level MDS/II Year/IV Semester

Full Marks 45  
Pass Marks 22.5  
Time 2hrs

*Candidates are required to give their answer in their own words as far as practicable.*

**Attempt ALL questions.**

**Group A [5 × 3 = 15]**

1. Explain the concept of visual perception and its significance in data visualization (1+2)
2. Explain how visual analytics combines visualization techniques with analytical capabilities. (3)
3. Provide examples of visualization methods suitable for each type: one-dimensional, two-dimensional, and multi-dimensional data. (1+1+1)
4. Describe the role of visual encodings in representing data visually. (3)
5. When visualizing tabular data with quantitative values, scatter plots are commonly used. (3)

**Group B [5 × 6 = 30]**

6. Discuss the principles and rules for graph drawing and labeling, including aspects like node placement, edge routing, and label positioning. Illustrate your answer with appropriate examples. (6)

**OR**

How can visualization be used to help analysts identify interesting patterns and trends in large datasets, and what are the limitations of these techniques? (3+3)

7. Describe the characteristics of time data in time series visualization. Explain visualization techniques for representing and analyzing time series data, and provide examples of suitable methods for different types of time series data. (2+4)
8. How can information overload be prevented in data visualization, and what techniques can be used to help viewers focus on the most important information? (3+3)

**OR**

What is visual mapping in the context of data visualization? Discuss the importance of visual mappings and provide examples of different types of visual mappings used to represent data effectively. (2+4)

9. Explain the key components of the visualization reference model and their roles in the data visualization process. (6)
10. Explain the concept of visual perception and its significance in data visualization. Discuss how human perception influences the design and interpretation of visual representations of data. (1+2+3)

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**Group A [5 × 3 = 15]**

1. How can scalar fields be visualized using contour plots?
2. What are some real-world applications where visualizing scalar volumes is beneficial?
3. Discuss the challenges associated with visualizing scalar volumes in three-dimensional space.
4. How can isocontours be effectively used to analyze spatial patterns in geographical data?
5. What are some advantages of using heat maps to visualize scalar fields?

**Group B [5 × 6 = 30]**

6. Explain the importance of considering user and data characteristics when evaluating visualization techniques. How do user characteristics and data characteristics impact the effectiveness of visualizations?

**OR**

What are the challenges and issues related to data that impact visualization? Explain the issues of data quality, data uncertainty, and data scalability in the context of visualization.

7. What are some common visualizations used to represent a single text document? Explain the concepts of word cloud, word tree, text arc, them escapes, and self-organizing maps.
8. Discuss the structures used for evaluating visualizations. What are some commonly used frameworks or approaches for assessing the effectiveness of visualization techniques?
9. When visualizing scalar fields, what are the different techniques you can use, and how do you represent isocontours, such as in topographic terrain maps?

**OR**

When visualizing vector fields, what are the techniques you can use to represent them? Additionally, explain the concept of defining marks and channels in data visualization.

10. When working with text and document data, what are the different levels of text representation that can be used? Explain each level briefly.

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**Group A**

**[5 × 3 = 15]**

1. You are designing a data visualization dashboard for a financial analytics company. The goal is to provide users with a clear understanding of complex financial data. Which visual encodings would you use to ensure effective representation and interpretation of the data? Justify your choices based on the principles of visual perception.
2. How can the capabilities and limitations of hardware devices, rendering engines, and software frameworks impact the design choices and performance of visualizations?
3. The dataset includes various attributes such as product categories, sales dates, and customer demographics. Using visual representations, how can visual analytics techniques be applied to identify patterns and trends in the sales data that can help the company optimize its marketing strategies.
4. Describe the mesocapes and self organizing maps.
5. When working with tabular data that includes quantitative values, what are some effective visualization methods for representing relationships or patterns?

**Group B**

**[5 × 6 = 30]**

6. Given the hierarchical structure of the dataset, design a tree diagram that represents the different product categories and subcategories. How does this visualization aid in understanding the organization and relationships within the product hierarchy? (6)

**OR**

Using scatter plot visualization, analyze the relationship between the amount spent by customers and the number of items purchased. How does the scatter plot help you understand the correlation between these two variables? Provide insights based on the scatter plot

7. Visualize a geographical map using dot or pixel marks to represent population density in different regions. How does this visualization technique help in understanding the distribution of population across the map? Discuss the advantages and limitations of using dot or pixel marks for mapping quantitative values. (3+3)