EXPT NO:4	Visual encoding of data
DATE: 20.01.2026	

PRE-LAB QUESTIONS

1. How does the human visual system process visual variables?
   The human visual system quickly interprets visual variables such as color, size, shape, and position, enabling fast pattern recognition and comparison.

2. Why is improper encoding misleading in analytics?
   Improper encoding can distort perception, hide critical insights, and lead to incorrect conclusions and decisions.

3. What are perceptual limitations in visualization?
   Humans have limited ability to distinguish similar colors, small size differences, and complex visual patterns in dense data.

4. How does color choice affect interpretation?
   Color influences attention and meaning; poor choices can confuse users, while good choices improve clarity and understanding.

5. Why should AI dashboards be perceptually optimized?
   Perceptually optimized dashboards reduce cognitive load, improve trust, and ensure correct interpretation of AI insights.

OBJECTIVE: To apply effective visual encoding principles for meaningful data communication.

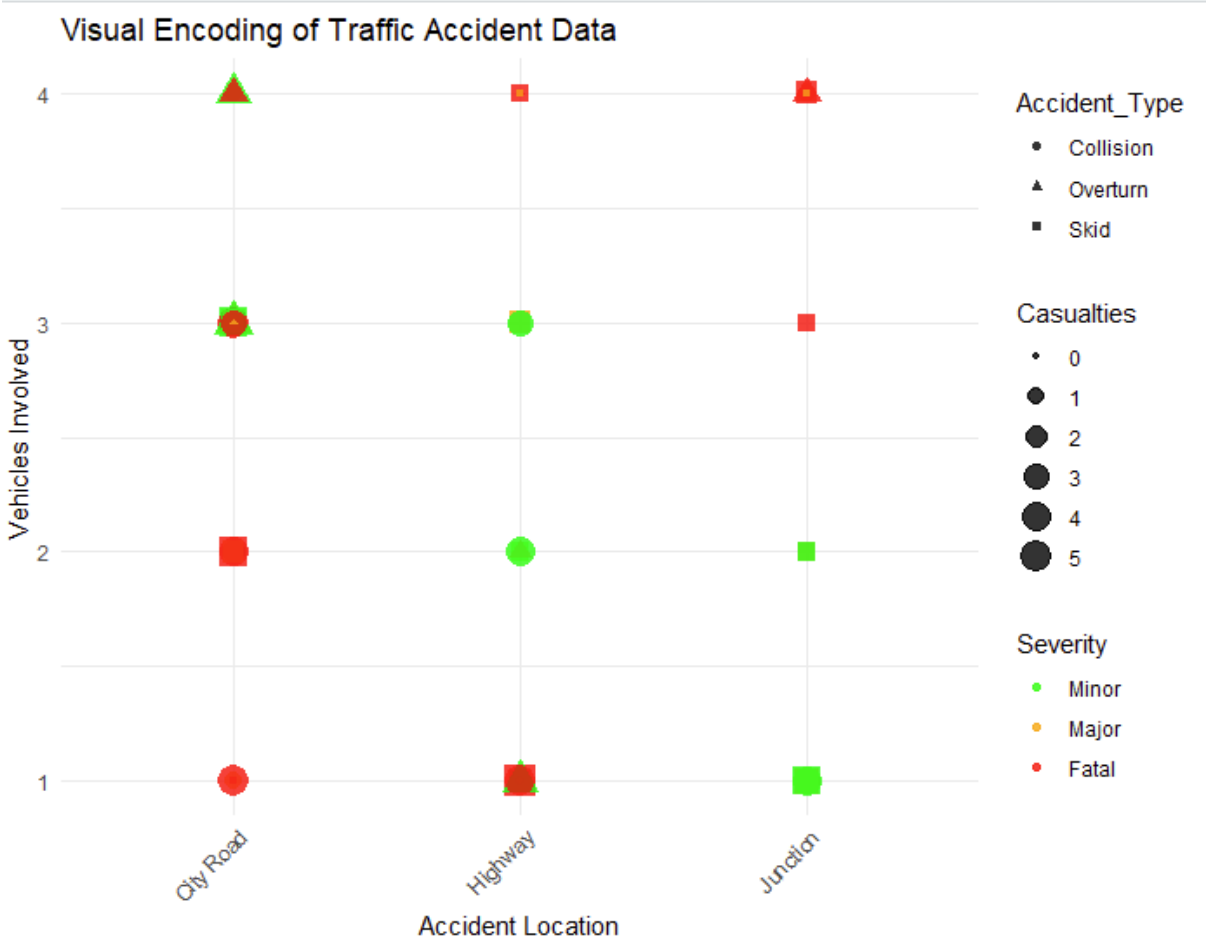
SCENARIO: A city traffic department analyzes accident data to identify high-risk zones and accident severity patterns.

IN-LAB TASKS (Using R Language) • Encode severity using color gradients • Represent accident frequency using size • Use shape to indicate accident type

CODE:

```
print("MOHANA DHARSHINI - 23BAD066")
library(ggplot2)
library(dplyr)
traffic <- read.csv("C:/Users/student/Downloads/4.traffic_accidents.csv")
str(traffic)
head(traffic)
traffic$Severity <- factor(
  traffic$Severity,
  levels = c("Minor", "Major", "Fatal"),
  ordered = TRUE
)
ggplot(traffic, aes(
  x = Location,
  y = Vehicles_Involved,
  color = Severity,
  size = Casualties,
  shape = Accident_Type
)) +
  geom_point(alpha = 0.8) +
  scale_color_manual(
    values = c("Minor" = "green", "Major" = "orange", "Fatal" = "red")
  ) +
  labs(
    title = "Visual Encoding of Traffic Accident Data",
    x = "Accident Location",
    y = "Vehicles Involved"
  ) +
  theme_minimal() +
  theme(
    axis.text.x = element_text(angle = 45, hjust = 1)
  )
```

```
> print("MOHANA DHARSHINI - 23BAD066")
[1] "MOHANA DHARSHINI - 23BAD066"
>
> # Load libraries
> library(ggplot2)
> library(dplyr)
>
> # Load the CSV
> traffic <- read.csv("C:/Users/student/Downloads/4.traffic_accidents.csv")
>
> # Check structure and first few rows
> str(traffic)
'data.frame':   50 obs. of  8 variables:
 $ Accident_ID      : int  7001 7002 7003 7004 7005 7006 7007 7008 7009 7010 ...
 $ Location         : chr  "Highway" "Highway" "Highway" "Junction" ...
 $ Date             : chr  "2024-06-01" "2024-06-02" "2024-06-03" "2024-06-04" ...
 $ Time             : chr  "Evening" "Evening" "Night" "Afternoon" ...
 $ Accident_Type    : chr  "Overturn" "Skid" "Overturn" "Collision" ...
 $ Severity         : chr  "Minor" "Minor" "Fatal" "Major" ...
 $ Vehicles_Involved: int  1 1 4 1 1 1 1 3 4 2 ...
 $ Casualties       : int  0 1 0 3 2 1 0 4 1 1 ...
> head(traffic)
  Accident_ID Location       Date      Time Accident_Type Severity Vehicles_Involved Casualties
1        7001  Highway 2024-06-01   Evening      Overturn    Minor                 1          0
2        7002  Highway 2024-06-02   Evening          Skid    Minor                 1          1
3        7003  Highway 2024-06-03     Night      Overturn    Fatal                 4          0
4        7004 Junction 2024-06-04 Afternoon     Collision    Major                 1          3
5        7005  Highway 2024-06-05   Evening          Skid    Minor                 1          2
6        7006  Highway 2024-06-06 Afternoon      Overturn    Minor                 1          1
>
```



POST-LAB QUESTIONS

1. Which visual variable best conveys severity and why?
   Color best conveys severity because it is immediately noticeable and intuitively associated with danger levels.

2. How can poor encoding mislead policy decisions?
   Poor encoding may hide high-risk zones or exaggerate minor issues, leading to ineffective or unsafe policy actions.

3. What precautions should be taken for color-blind users?
   Use color-blind-safe palettes, combine color with size or shape, and avoid relying on color alone.

4. How does visual encoding affect AI explainability?
   Effective encoding makes AI results more interpretable and transparent, improving user trust and understanding.

5. Suggest improvements for large-scale public dashboards.
   Interactive filters, simplified visuals, accessible color schemes, and responsive layouts improve usability.

LEARNING OUTCOME: Students learn perceptually effective visual communication for AI systems.

ASSESSMENT

Description	**Max Marks**	**Marks Awarded**
Pre Lab Exercise	**5**	
In Lab Exercise	**10**	
Post Lab Exercise	**5**	
Viva	**10**	
Total	**30**	
	Faculty Signature	