INFORMATION VISUALIZATION
PROJECT 3

Group - 7

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INTRODUCTION:

For this project, we have considered the dataset – **"cars"**

A wide range of automobile models are covered in the collection, together with information about their manufacturer, miles per gallon (MPG), number of cylinders, engine displacement, horsepower, weight, acceleration, model year, and location of origin.

DATASET EXPLANATION:

The dataset includes automobiles produced by American, European, and Japanese automakers in several model years.

The examination of this dataset may yield valuable information about patterns in automobile engineering, fuel economy, and performance attributes over various timeframes and geographical areas. It might also be used to create predictive models based on characteristics like engine specs and weight for things like fuel efficiency.

Car: Each car's name or model is listed in this column. It acts as a unique identifier for every dataset entry.

Manufacturer: The name of the company that makes each vehicle. Cars made by manufacturers like Chevrolet, Ford, Toyota, and so forth are categorized using this characteristic.

Miles Per Gallon, or MPG, is a measurement of an automobile's fuel efficiency that shows how far it can go on a single gallon of fuel. Greater MPG numbers typically correspond to more fuel efficiency.

Cylinders: The quantity of cylinders in the engine of the vehicle. This variable shows the size and power output of the engine; larger engines are generally connected with higher performance. Displacement: The engine's displacement, often expressed in liters or cubic inches. It stands for the entire amount of fuel and air that can be pulled into the cylinders in a full cycle.

Horsepower: The engine's power output, usually expressed in horsepower (hp). Higher horsepower figures correspond to more powerful engines and show the engine's work capacity.

Weight: The vehicle's weight, commonly expressed in kilograms (kg) or pounds (lbs). It symbolizes the mass of the car and has an impact on handling, performance, and fuel economy, among other things.

Acceleration: The time it takes for an automobile to accelerate from 0 to 60 kilometers per hour (mph). It shows the speed at which the vehicle can accelerate from a stop.

Model Year: The year that a particular type of car was produced. This variable makes it easier to monitor how automotive technology and design have evolved throughout time.

Origin: The nation or place of manufacture of the automobile. It divides cars into groups according to where they were made, including American, European, and Japanese.

Every one of these qualities offers useful knowledge regarding the performance, efficiency, and manufacturing specifics of the cars in the dataset. Finding patterns, trends, and correlations by examining the connections between these variables can be helpful for a number of things, like analyzing past data to forecast future performance or comprehending market trends.

Identifying at least three visualization tasks for the dataset: “Cars”

This dataset includes detailed data on a wide variety of automobiles, including important characteristics like MPG, the number of engines, displacement, horsepower, weight, acceleration, model year, and country of origin. With access to such comprehensive data, analysts are able to examine the subtle differences between different car models, spot trends in automotive technology and design, evaluate the effects of changing regulations on fuel economy, and investigate the variations in consumer preferences between markets and manufacturers. This information is also a great tool for creating prediction models, helping the automobile industry make strategic decisions, and educating consumers about the features and performance of various cars.

The visualization tasks which we have considered for the dataset “Cars” have been listed below:

1.Distribution of Vehicle Origins

2.Impact of horsepower on Vehicle Weight

3. Fuel efficiency

1. Design a visualization system to fulfil the identified tasks!

I. The visualization systems to fulfil the identified tasks are listed below:

Fuel efficiency:

Visual Representation: Pie Chart

This visualization's job is to examine how fuel efficiency is distributed among various car kinds or categories in the dataset. Specifically, it divides the vehicles into three groups according to fuel economy: 0–15 MPG, 16–30 MPG, and 31–45 MPG. Determining trends and making informed decisions about policy-making or vehicle selection can be aided by an understanding of fuel efficiency patterns.

```
<script>
    const data = [
        { MPG: "0-15", count: 150, color: "#4daf4a" },
        { MPG: "16-30", count: 200, color: "#377eb8" },
        { MPG: "31-45", count: 100, color: "#ff7f00" }
    ];

    const svgContainer = d3.select("svg"),
          radius = Math.min(400, 400) / 2,
          svg = svgContainer.append("g")
                  .attr("transform", `translate(${200}, ${200})`);

    const pie = d3.pie().value(d => d.count),
          arc = d3.arc().innerRadius(0).outerRadius(radius),
          data_ready = pie(data);

    svg.selectAll('path')
        .data(data_ready)
        .enter().append('path')
        .attr('d', arc)
        .attr('fill', d => d.data.color)
        .attr('class', 'segment')
        .on("mouseover", function(event, d) {
            d3.select(this).attr('opacity', 1);
            d3.select(".tooltip").html(`MPG Range: ${d.data.MPG}<br>Count: ${d.data.count}`)
                                 .style("opacity", 1)
                                 .style("visibility", "visible")
                                 .style("left", `${event.pageX - 100}px`)
                                 .style("top", `${event.pageY - 50}px`);
        })
        .on("mouseout", function() {
            d3.selectAll('.segment').attr('opacity', 0.7);
            d3.select(".tooltip").style("opacity", 0).style("visibility", "hidden");
        });

    d3.selectAll('.segment').attr('opacity', 0.7);

    const legendContainer = d3.select(".legend");
    data.forEach(d => {
        legendContainer.append("div")
            .attr("class", "legend-item")
```

1. **Impact of horsepower on Vehicle Weight:**

Visualization Representation: Scatter Plot

```
<head>
    <meta charset="UTF-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <title>Scatter Plot</title>
    <script src="https://d3js.org/d3.v7.min.js"></script>
    <style>
        body {
            background-image: url('background.jpg'); /* Ensure this path is correct */
            background-size: cover;
            background-position: center;
            background-attachment: fixed; /* Fix background image during scrolling */
            display: flex;
            flex-direction: column;
            justify-content: space-between;
            align-items: center;
            height: 100vh;
            margin: 0;
            text-align: center;
            color: #0a0909;
        }
        #chart-container {
            display: flex;
            justify-content: center;
            align-items: center;
            width: 60%;
            height: 60%;
            margin: auto;
        }


        svg {
            background-color: #f4f4f4;
            border: 1px solid #ddd;
        }
        .tooltip {
            position: absolute;
            text-align: center;
            width: auto;
```

2. **Distribution of Vehicle Origins:**

Visualization Representation: Bar chart

```
// Set dimensions and margins of the graphs
const margin = {top: 20, right: 30, bottom: 100, left: 60}, // Adjusted margin
      width = 460 - margin.left - margin.right,
      height = 400 - margin.top - margin.bottom;

// Bar Chart SVG
const svgBar = svgContainer.append("svg")
    .attr("width", width + margin.left + margin.right)
    .attr("height", height + margin.top + margin.bottom)
    .append("g")
    .attr("transform", `translate(${margin.left}, ${margin.top})`);

const xBar = d3.scaleBand()
    .range([0, width])
    .domain(originCounts.map(d => d.key))
    .padding(0.1);
svgBar.append("g")
    .attr("transform", `translate(0, ${height})`)
    .call(d3.axisBottom(xBar));
// X-axis label for bar chart
svgBar.append("text")
    .attr("text-anchor", "middle")
    .attr("x", width / 2)
    .attr("y", height + margin.bottom - 20)
    .text("Origin");
const yBar = d3.scaleLinear()
    .domain([0, d3.max(originCounts, d => d.value)])
    .range([height, 0]);
svgBar.append("g")
    .call(d3.axisLeft(yBar));
// Y-axis label for bar chart
svgBar.append("text")
    .attr("transform", "rotate(-90)")
    .attr("y", -margin.left + 15)
    .attr("x", -height / 2)
    .attr("text-anchor", "middle")
    .text("Count of Manufacturer");

svgBar.selectAll(".bar")
    .data(originCounts)
    .enter().append("rect")
```

The analysis of the car origin distribution among the manufacturers in the dataset is the goal of this graphic. In order to obtain insight into the geographic distribution of car production, our specific goal is to comprehend the number of manufacturers linked to each origin type (American, European, and Japanese).

I. Every visual representation has inherent limitations, such as the incapacity to display a lot of information at once, the potential for congested categories or data points, and the difficulty of comparing multiple variables at once. To get over these problems and boost the efficiency of the visualization system, a range of interactions can be used.

1. **Fuel Efficiency:**

   Tooltip: A tooltip indicating the precise range and the number of vehicles falling into each range appears when a user hovers over a pie chart section that represents a distinct MPG range.

Click Interaction: By clicking on a section of the pie chart, users can make it stand out from the rest of the chart and temporarily isolate it. Users can concentrate on particular MPG ranges for in-depth examination thanks to this.

2. **Impact of horsepower on Vehicle Weight**:

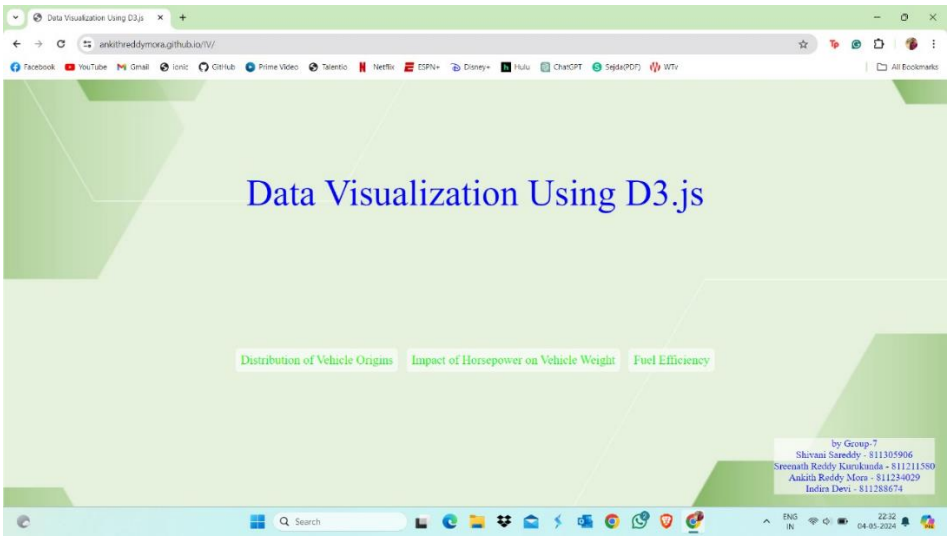
   Tooltip: To facilitate accurate data scrutiny, when you hover over data points on the scatter plot, a tooltip displaying the precise weight and horsepower values for that specific vehicle will appear.
   Brushing: To filter and emphasize vehicles that fall within a given range of data points on the scatter plot, users can draw a selection box (brush) over that range. This makes it possible to investigate the link between weight and horsepower in real time.

3. **Distribution of Vehicle Origins:**

Tooltip: When you hover over a bar in the bar chart, a tooltip will appear, providing more details like the manufacturer count and the origin category (Japanese, European, or American).

Sorting: To arrange the bars in the bar chart in either ascending or descending order according to the number of manufacturers, users can select a button or use a dropdown menu. This gives users more freedom to investigate the origins of vehicles.

II. Implement the Web-based visualization system with interactions

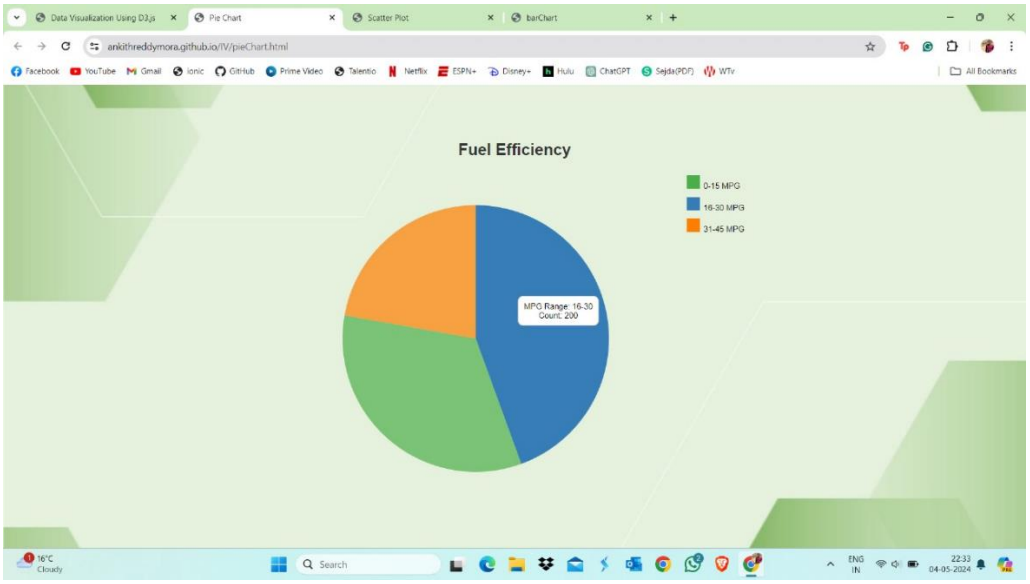


1. **Fuel Economy (Pie Diagram):**

   The first step in creating a pie chart for the fuel economy visualization is to

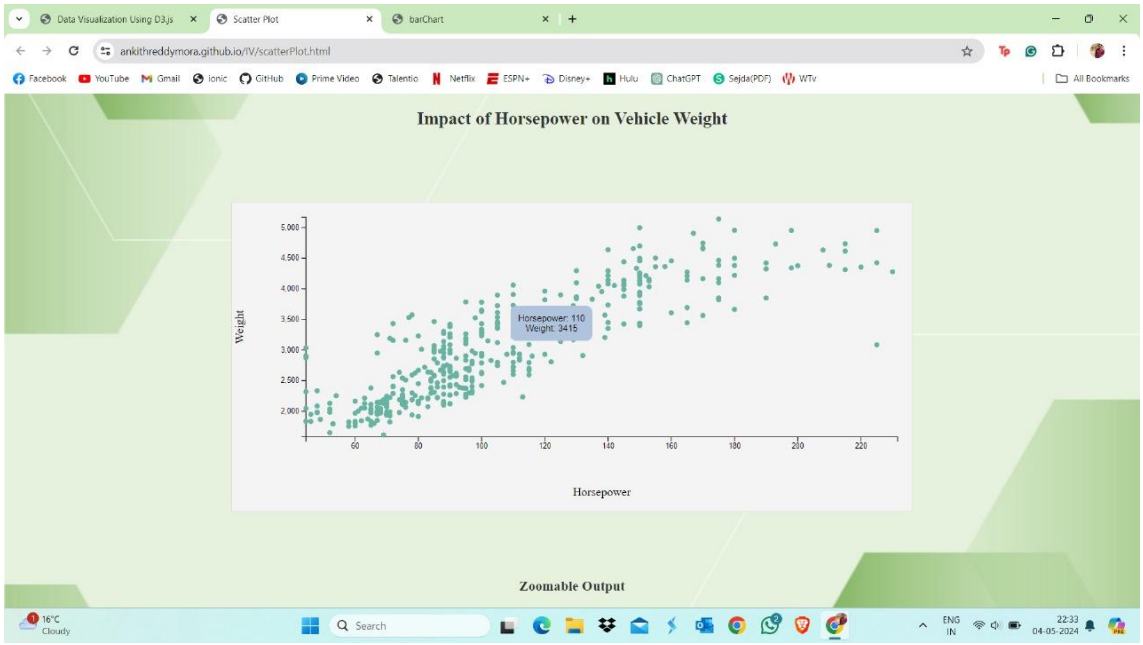
define your dataset. The fuel efficiency categories (such as 0–15 MPG, 16–30 MPG, and 31–45 MPG) and the accompanying counts of vehicles falling into each category would be included in this dataset.

Next, you would determine the dimensions of an SVG container that would hold your pie chart using D3.js. After your dataset has been transformed into arc data appropriate for a pie chart, you would use D3's d3.pie () function to construct a pie layout.
After obtaining the pie pattern, you would use your dataset to create the arcs for each pie slice. For each slice, SVG path elements are created using D3's arc generator.
You may also include tooltips to show details about each slice when the mouse is over them, and click interactions to show further information or perform actions when the mouse is over a slice.



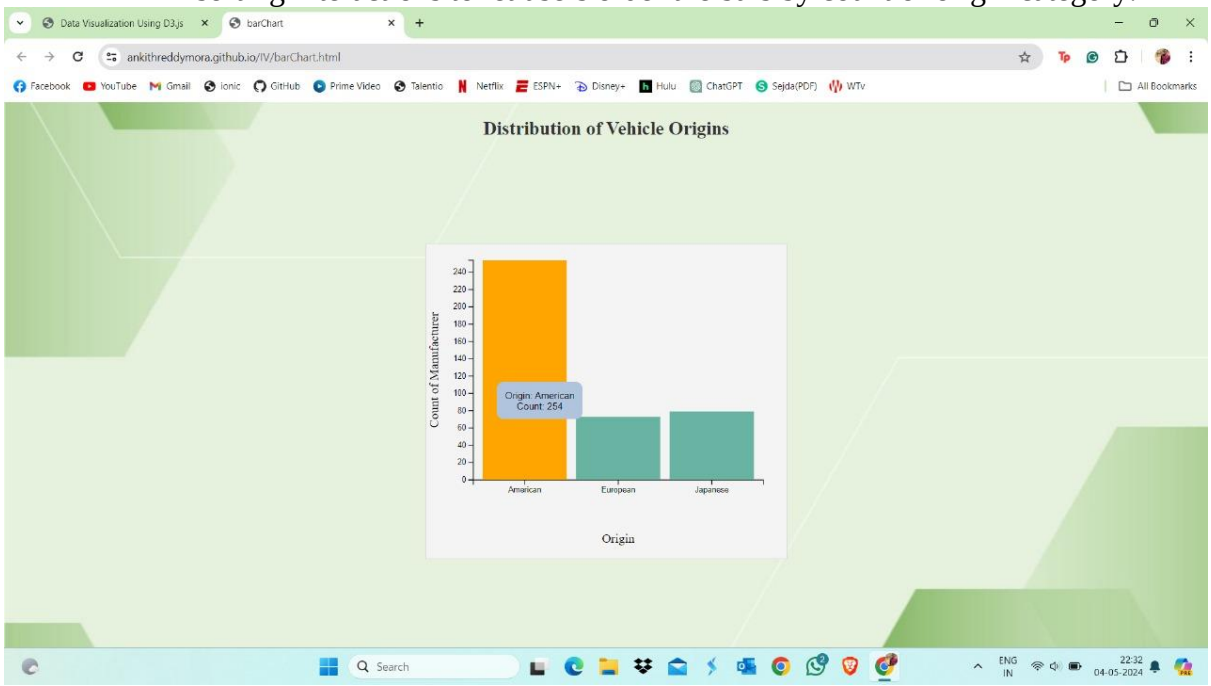
2. **Effect of Vehicle Weight on Horsepower (Scatter Plot):**

You would begin by establishing your dataset with pairs of horsepower and weight values for each vehicle in order to create the scatter plot visualization that illustrates the relationship between horsepower and vehicle weight.
In a similar manner, you would determine the dimensions and set up an SVG container to house your scatter plot. Next, you would use D3's d3. scale Linear() method to define scales for the x-axis (horsepower) and y-axis (weight).
The next step would be to draw circles for every data point in your dataset, placing them according to the weight and horsepower values that correspond to them and using the previously established scales.
Tooltips that provide details about each data point when it is hovered over and brushing interactions that let users pick and highlight particular data points or regions of interest are two ways to add interactions.



3. **Vehicle Origins Distributed (Bar Chart):**

   You would define your dataset with categories of vehicle origins (e.g., American, European, Japanese) and the matching counts of manufacturers for each origin category in order to create the bar chart visualization that displays the distribution of vehicle origins.
   Similarly, you would define the scales for the x- and y-axes (counts) and put up an SVG container. The height of each bar would thus indicate the number of manufacturers for each origin category in your dataset. You could add click interactions to provide more information or actions when a bar is clicked, and sorting interactions to let users order the bars by count or origin category.



CONCLUSION:

The dataset offers a comprehensive overview of automotive attributes by incorporating factors such as weight, horsepower, fuel efficiency, and place of manufacture. Visualizations such as the bar chart displaying the origins of vehicles, the scatter plot illustrating the relationship between horsepower and weight, and the pie chart displaying fuel efficiency can provide users with significant information. Some examples of interactions that improve user engagement and data exploration efficiency are sorting systems, tooltips, and click actions. The fuel efficiency pie chart illustrates the MPG ranges, which facilitates understanding of usage trends. A crucial component of performance research, the scatter plot allows for the investigation of the link between vehicle weight and horsepower in the interim.

Webpage URL: https://ankithreddymora.github.io/IV/