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**COMSATS University Islamabad (CUI)**

**Project Report**

**for**

**Semester Project**

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***Bachelor of Science in Data Science (2022-2026)***

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**BIKE SHARING — Data Visualization Project**

# **Project Overview:**

This project focuses on developing an **interactive data visualization dashboard** using **D3.js**, designed to explore a public bike-sharing dataset. It highlights ride patterns over time, differences between user types (member vs casual), and the usage trends of various bike types. The main goal is to make complex data **visually intuitive, interactive, and insightful**.

# **Data Source:**

* **Dataset**: Combined & cleaned ride data from **Divvy Bike Sharing System**
* **Time Period**: October 2021 to March 2022 (6 months)
* **Source**: [Kaggle Public Datasets](https://www.kaggle.com)
* **Format**: .csv after cleaning

# **Data Features:**

|  |  |
| --- | --- |
| ride\_id | Unique identifier for each ride |
| rideable\_type | Type of bike used (classic/electric/docked) |
| member\_casual | User category: member or casual |
| started\_at | Ride start timestamp |
| ended\_at | Ride end timestamp |
| duration\_min | Duration of the ride in minutes |
| month | Month in YYYY-MM format |
| day\_of\_week | Day of the week |
| hour | Hour of day (0–23) |
| start\_station\_name | Name of the start station (optional) |
| end\_station\_name | Name of the end station (optional) |

# **Data Cleaning & Preprocessing:**

* Merged multiple monthly CSV files
* Removed nulls, duplicates, and negative durations
* Filtered dates from **Oct 2021 to Mar 2022**
* Derived additional fields:
  + duration\_min from started\_at and ended\_at
  + month, hour, and day\_of\_week using date parsing

The final cleaned file: data/cleaned\_bike\_data.csv

# **Choice of Visualizations and Their Justification:**

### 5.1 Line Chart: Monthly Ride Trends by User Type

* **Why**: To track how ride volumes change month-to-month
* **What**: X-axis = months, Y-axis = number of rides
* **Interactive Elements**:
  + Zoomable time scale
  + Tooltip on data points
  + Toggle lines for member/casual

### 5.2 Bar Chart: Bike Type Distribution by User Type

* **Why**: Compare rideable types across user groups
* **What**: Count of ride types for each user category
* **Interactive Elements**:
  + Filter dropdown (All / Member / Casual)
  + Tooltips for count display

### 5.3 Scatter Plot: Ride Duration vs Hour of Day

* **Why**: Discover hourly usage and ride time patterns
* **What**: X = hour, Y = duration in minutes
* **Interactive Elements**:
  + Color & shape differentiation by bike type
  + Zoomable X-axis
  + Hover tooltip
  + Right-side legend for shape explanation

### 5.4 Pie Chart: Member vs Casual Users Distribution

* **Why**: Show proportional split of users
* **What**: Percent and count per user type
* **Interactive Elements**:
  + Tooltip with dynamic percentages
  + Hover expansion animation

### 5.5 Tree Map: User Type & Rideable Type Breakdown

* **Why**: Nested grouping of ride volume
* **What**: Color-coded blocks for category breakdown
* **Interactive Elements**:
  + Tooltip showing type and ride count
  + Hover highlighting

# Interaction Techniques Implemented:

|  |  |
| --- | --- |
| Technique | Applied To Charts |
| Tooltip on hover | All charts |
| Zooming | Line Chart, Scatter |
| Dropdown Filters | Bar, Scatter |
| Shape & color codes | Scatter, Pie |
| Toggle checkboxes | Line Chart |
| Chart switching | All (via header buttons) |

## 7. Design Quality and Aesthetic Considerations

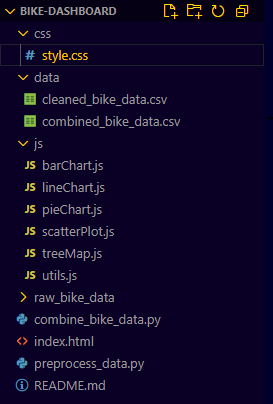
* Clean layout using **semantic HTML + modular CSS**
* Color palette is **accessible and consistent**
* All tooltips use **shared style**
* Legends provided for clarity
* Charts are responsive within a fixed-width dashboard

# 

# 8. Challenges Encountered and Solutions Applied:

|  |  |
| --- | --- |
| **Challenge** | **Solution** |
| Tooltip appearing at wrong location | Switched to d3.pointer() for precise container-relative positioning |
| Chart overlap due to DOM structure | Modularized chart containers and cleared them on reload |
| Shape legend confusion | Used custom d3.symbol() for right-aligned legend |
| Tooltip duplication | Created shared tooltip element reused across charts |

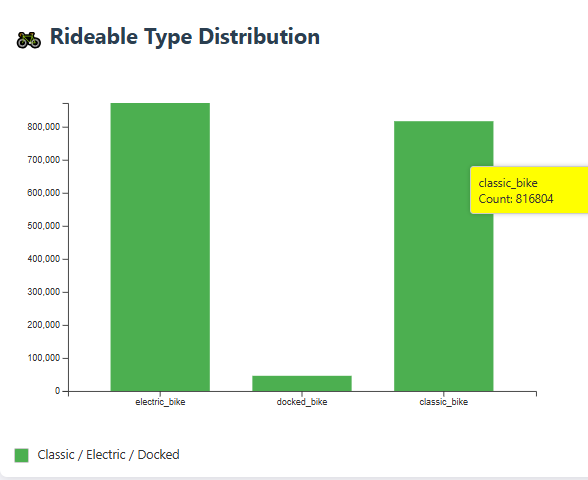
9. Project Setup:

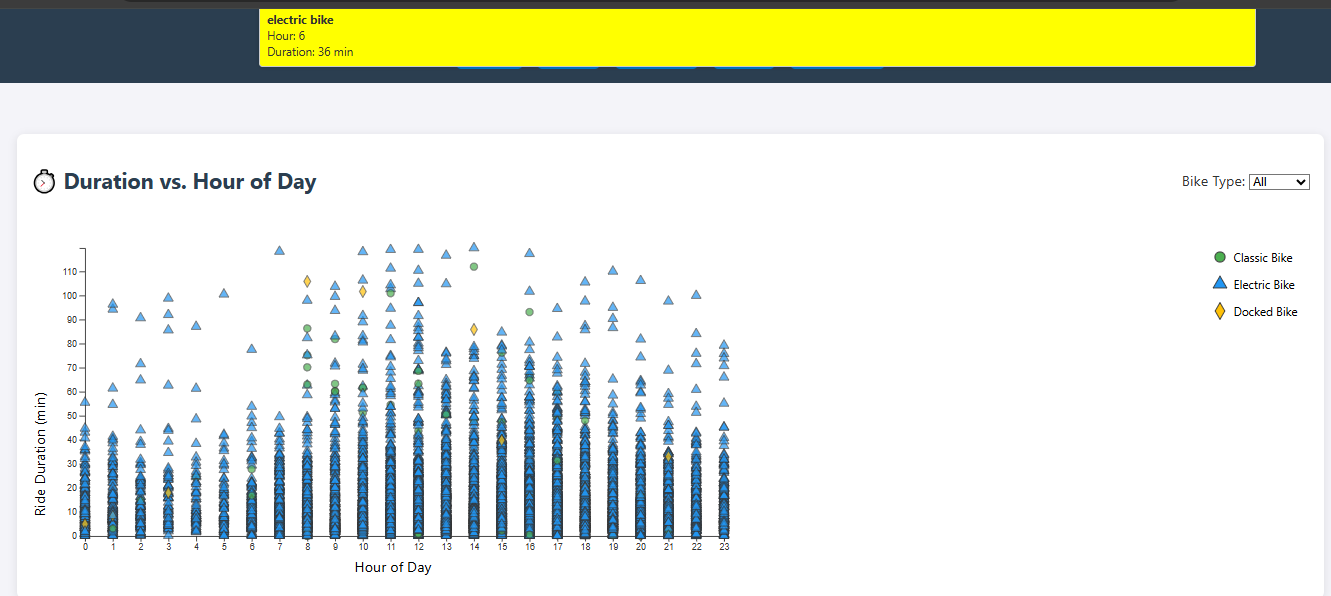


# 10. Key Insights from the Visualizations

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