Assignment 2: Design a static visualization

- **Question Proposed:** How did students' weekly activity patterns (screen time, outdoor activities, family time, etc.) and cognitive performance (reaction time & memory score) change before and after COVID-19 across gender groups?
- **Dashboard Link : [Dashboard: Shifts in Student Activities and Cognitive Performance Before and After COVID-19]**
- **Data Preprocessing Steps (Programming language: Python, Libraries: pandas, numpy)**
    - **Subset Selection:** Extracted relevant columns from the dataset for analysis.
    - **Data Type Validation & Cleaning:** Identified and corrected invalid string values in numeric fields. Dropped unusable records with null or incorrect data records.
    - **Age Filtering:** Retained only records for students aged **10 to 18**.
    - **Outlier Handling:** Detected and removed records with unrealistic extreme values in numeric fields.
    - **Data Type Conversion:** Ensured all variables had appropriate data types for analysis.
    - **Feature Engineering:**
        - Created **pre-COVID (≤2019) and post-COVID (>2019)** labels using *DataYear*.
        - Generated **age groups**: *Below 13* and *Above 13* based on *AgeYears*.
- **Vizualization Tool: Tableau**
- **Findings:**

Chart Name	Chart Type	Key Findings
Weekly Average Activity Hours (2014–2024)	Line Chart	Overall, Screen-based activities (video games, watching TV, computer use) increased after COVID-19, especially computer use, which has significantly increased for both groups. During the pandemic, females' watching TV hours increased, whereas males' video games hours increased. Outdoor activities and family time decreased. Homework hours remained stable.
COVID Impact on Weekly Activity Hours by Gender	Bar Chart	Females spent significantly more time on computer use post-COVID. Males also increased screen time but to a lesser extent. Outdoor activities and family time dropped, especially for females.
Average Seconds Spent on Cognitive Activities (Reaction Time & Memory Score) by Gender	Bar Chart	Females had slightly longer reaction times than males. Also, both male and females have slight improvement on reaction time post-COVID period. Memory scores remained stable, with no significant pre- vs. post-COVID changes.
COVID Impact on Reaction Time by Gender & Age Group	Box Plot	Younger students (below 13) had slightly faster reaction times compared to older students. Males consistently showed lower reaction times than females.

Based on the findings, students' weekly activity patterns and cognitive performance exhibited noticeable changes before and after COVID-19, with differences observed across gender groups:

In summary, after COVID-19, students, especially females, increased their screen time at the expense of outdoor activities and family time. Cognitive performance, particularly in terms of reaction time has reduced after covid, and memory scores, remained relatively stable, with no major changes observed before and after COVID-19 across gender groups.

- **Design Decisions and Rationale:**

1. **Chart Selection**:
    - **Line Chart for Weekly Average Activity Hours (2014–2024)**: The line chart was chosen to show the trend over time, highlighting the change in students' activity patterns over the past decade. It effectively illustrates how the different activity types (screen time, outdoor activities, family time, etc.) have evolved, especially the spike post-COVID. A line chart was ideal here as it emphasizes the continuous nature of time and enables clear tracking of these patterns across years.

    - **Bar Charts for COVID Impact on Weekly Activity Hours by Gender, Cognitive Activities (Reaction Time & Memory Score) by Gender, and COVID Impact on Reaction Time by Gender**: Bar charts were used for comparisons between gender groups across specific categories

like screen time, outdoor activities, reaction time, and memory scores. Bar charts are effective for categorical comparisons, providing a clear visual representation of differences across gender and age groups. For example, the **COVID Impact on Weekly Activity Hours by Gender** bar chart compares how screen time, outdoor activities, and family time changed for males vs. females post-COVID.

    - The **Cognitive Activities box and whisker plots** compare reaction times between males and female by age groups, making it easy to identify trends or differences in performance. Also helps to identify outliers and data distributions.

2. **Visual Encodings**:
    - **Color**: I used color coding to differentiate between genders and activity types across the charts. This was based on the principle of visual distinction, where colors make it easy for viewers to understand and compare categories quickly.
        - For example, distinct colors were applied to male and female data to make gender differences easy to identify in the bar charts.
    - **Position**: The position of elements on the charts (e.g., bar heights for cognitive performance or activity hours) was used to communicate quantitative differences. This choice aligns with theoretical foundations in visual perception, where people naturally associate vertical positions with magnitude.

    - **Shape and Size**: In the line chart, different colored lines were used to represent different activity types. The size of the bars in bar charts was used to directly reflect the value of the measured variable (e.g., hours spent on each activity or reaction time).

Design Iterations:

1. **Initial Iteration**: Initially, I considered using heat maps to show the correlation between variables but identified that, with fewer points, it is not accurate. I used pie charts to show proportions of weekly activity hours before and after COVID-19. However, the pie charts did not visualize the differences that I wanted to highlight (e.g., showing change before and after COVID), so I switched to a stacked bar chart, which clearly shows activity time compositions.

2. **Adjustments in Data Representation**: Initially, I had thought about representing all data in a single, stacked bar chart. However, this created complexity and made comparisons between different activities challenging. Therefore, I opted for separate bar charts to allow a more focused comparison of each variable (e.g., reaction time and memory scores separately).

3. **Gender-Specific Bar Charts**: In some versions, I grouped both male and female data in the same bar, but this made it hard to distinguish trends. To improve clarity, I decided to use side-by-side bars (grouped by gender), which improved the visual differentiation.

Lessons Learned:

1. **Importance of Clarity**: Clear and simple visuals are crucial to avoid clutter and confusion, especially when differentiating groups like gender. Distinct visuals enhance readability.
2. **Choosing the Right Chart Type**: Selecting the appropriate chart type is vital—line charts for time-based trends and bar charts for categorical comparisons worked better than other alternatives.
3. **Iterative Refinement**: The initial design is just a starting point; iterative improvements based on feedback and usability tests help in simplifying visuals and improving understanding.
4. **Context Matters**: The context, such as COVID-19's impact, must be clear throughout the design process to ensure the significance of data changes is well understood.
5. **Data Preprocessing is Key**: Proper handling of missing values and outliers is essential for ensuring accurate trends and meaningful insights.

In my perspective, aligning visual design with the data's purpose and iterating based on feedback ensures clarity and effective communication of insights.