1. Objective

The project aims to analyze and understand how **trader behavior** (profits, leverage, volume, and trade counts) varies with **market sentiment**, particularly during **"Fear"** and **"Greed"** phases. By integrating trading and sentiment datasets, the analysis explores whether emotional market conditions influence trading performance and risk behavior.

2. Datasets Used

- **Trading Dataset (historical_data.csv)**
    - Contains individual trading records with timestamps, account IDs, position size (USD), leverage, and profit/loss data.
- **Sentiment Dataset (fear_greed_index.csv)**
    - Includes daily market sentiment classifications (e.g., "Fear", "Greed") based on external financial sentiment indicators.

Both datasets are merged by date for unified analysis.

3. Preprocessing Steps

- **Data Loading & Inspection**
    - Loaded both datasets using **Pandas** and verified their dimensions and structure.
- **Datetime Conversion:**
    - Converted Timestamp IST and date columns to proper datetime format.
- **Feature Extraction:**
    - Extracted date component from timestamps to align trading data with daily sentiment.
- **Data Cleaning:**
    - Removed invalid or missing date entries.
- **Aggregation:**
    - Aggregated trading metrics **per day**, computing:
        - total_volume (sum of USD traded)
        - avg_leverage (mean leverage used)
        - total_profit (sum of closed PnL)
        - trade_count (number of trades per day)

4. Data Integration

- Merged the **aggregated trading data** with **sentiment classifications** based on the common date field.
- The resulting dataset (merged_trader_sentiment.csv) provides a day-level view linking **trading behavior** and **market sentiment**.

5. Exploratory Data Analysis (EDA) Techniques

The exploratory analysis focused on understanding how **market sentiment classifications** — *Fear, Neutral, Greed, Extreme Greed,* and *Extreme Fear* — influenced overall trading profitability.

Profit Distribution by Market Sentiment

The boxplot visualization (shown above) reveals distinct behavioral patterns:

- **Fear & Extreme Fear:**
  - Profits during these phases are **highly scattered**, with several **positive outliers**, suggesting that while most traders incur small or near-zero gains, a few capitalize on volatile markets to secure substantial profits.
  - The **median profit** tends to hover close to zero, indicating cautious or risk-averse trading behavior.
- **Neutral Sentiment:**
  - Trading outcomes remain **tightly clustered around zero**, implying limited volatility and stable market conditions.
  - This suggests balanced trader sentiment and minimal speculative activity.
- **Greed & Extreme Greed:**
  - These periods show **larger positive outliers** and slightly wider dispersion in profits, suggesting increased **risk-taking and trading volume**.
  - Despite the optimism, the median remains near zero, indicating that while a few traders achieve high profits, the average trader's returns do not significantly improve.

Interpretation

The distribution indicates that:

- **Volatility-driven opportunities** emerge during "Fear" and "Extreme Greed" phases, but with inconsistent outcomes.
- **Extreme sentiment conditions** (both Fear and Greed) produce **greater variance** in trading performance — signaling elevated risk exposure.
- **Neutral markets** favor steady, low-risk strategies with minimal deviations in profits.

Conclusion from EDA

Market sentiment exerts a visible impact on trading performance — traders tend to take **larger positions** and experience **wider profit variability** when emotions dominate the market. This supports the behavioral finance hypothesis that **emotional extremes amplify market risk and opportunity simultaneously**.

6. Insights & Observations

- **Profitability Trends:**
  Average profits tend to differ across sentiment categories — suggesting trader performance correlates with emotional market conditions.
- **Risk Appetite:**
  Traders show varying leverage usage during Fear vs. Greed phases, implying changing risk tolerance.
- **Volume Patterns:**
  Trading volumes reflect overall market enthusiasm, peaking during greed-dominant periods.
- **Behavioral Interpretation:**
  The study provides empirical evidence of **sentiment-driven trading behavior**, aligning with behavioral finance theories.

7. Tools and Libraries

- **Data Handling:** pandas, numpy
- **Visualization:** matplotlib, seaborn
- **Workflow Management:** pathlib for structured file handling

8. Output

- **Merged Dataset:** merged_trader_sentiment.csv
- **Statistical Insights:** Average profit differences across sentiment states.
- **Visual Summaries:** Sentiment-based profit, leverage, and volume distributions.

9. Conclusion

PrimeTradeAI effectively integrates trading and sentiment data to uncover patterns linking **emotional market states** with **financial outcomes**.
The results highlight how **fear and greed** influence traders' profitability, leverage behavior, and overall activity, offering valuable insights for developing **sentiment-aware trading strategies** or **behavioral risk assessment tools**.