Weekly Report: Shalha Mucha Alpha AI

Week-03 (May 5 - May 9)

Mathematics for Machine Learning

Course: Linear Algebra

- Vectors were understood as representations of both direction and multi-attribute data.
- Vector operations were explored, including addition, subtraction, and scaling.
- The dot product was introduced as a method for measuring the alignment between vectors
- The concept of magnitude was grasped through internal vector structure.
- Projections were studied to understand how one vector aligns with another.
- Coordinate systems were redefined using custom basis vectors for flexible representation.
- Vector spaces were framed using basis vectors that define dimensionality
- Linear independence was emphasized as essential for determining space dimensionality.
- Noise and structure were separated by projecting data onto more informative bases.
- Matrix transformations were categorized into scaling, rotation, reflection, and shear.
- Composed transformations were applied by combining multiple matrices in sequence.
- Systems of equations were solved using Gaussian elimination.
- Matrix inverses were used to reverse transformations and solve linear systems.

- Orthonormal bases were utilized to simplify projections and computations
- Stable directions were revealed through eigenvectors and their associated eigenvalues.

Git and GitHub:

- Completed the GitHub Documentation

Tesla Project:

- Delivered an in-depth session on Machine Learning, emphasizing practical applications.
- Carried out extensive data preprocessing tasks such as managing missing values, converting date columns to datetime format, and setting them as the index.
- Created new features—including monthly returns, various moving averages (MA5, MA10, MA20), and rolling standard deviation—to enhance prediction accuracy.
- Performed thorough Exploratory Data Analysis (EDA) with visual tools to uncover trends, seasonal effects, and volatility patterns.
- Developed and trained a range of models for stock prediction: Linear Regression, XGBoost, Decision Tree Regressor, Random Forest Regressor, LSTM, GRU, and ensemble models like Voting Regressor.
- Emphasized model evaluation under conditions of high market volatility, using metrics such as MAE, MSE, RMSE, R^2, and MAPE to measure performance.
- Implemented walk-forward validation to assess generalization on future data, followed by optimization and fine-tuning for improved outcomes.
- Compared the performance of basic models (e.g., Simple Moving Average, Linear Regression) with advanced algorithms (e.g., LSTM, XGBoost) to identify the most effective forecasting strategy.

- Compiled a comprehensive performance review, highlighting model behavior during volatile periods and suggesting directions for further refinement.

Coding Practice

- Solved several Easy and Medium-level problems on LeetCode to strengthen problem-solving and algorithmic skills.