PROJECT SYNOPSIS

Project Title

Portfolio Optimization System using Machine Learning & Deep Learning

Project Contributors

6 - week Summer Internship on Python & Machine Learning

- **Saisha Verma** (18101012024, B. Tech, CSE - 3, 2nd Year)
- **Ritisha Sood** (17201012024, B.Tech, CSE - 3, 2nd Year)

Objective

The objective of this project is to build a **machine learning and deep learning-based portfolio optimization system** that dynamically suggests optimal asset allocations based on historical data, aiming to maximize returns while minimizing risk.

Problem Statement

Traditional investment strategies rely on fixed rules that may not adapt well to changing market conditions. This project addresses the question : ***"Can we use deep learning and machine learning to create smarter, adaptive portfolio strategies that improve returns while managing volatility?"***

Methodology

1. Data Collection

- Automated fetching of historical OHLCV data using **yfinance.**
- **Assets :** VTI (Stocks), AGG (Bonds), DBC (Commodities), VIX (Volatility).

2. Data Preprocessing

- Clean missing values, calculate returns and volatility.
- Feature creation includes : Moving averages, Daily/weekly returns, Rolling standard deviations

3. Fixed Allocation Strategies (Traditional Baselines)

- Equal weight strategy
- Equity-dominant or bond-focused allocations

- Balanced portfolios

4. Deep Learning Model

- Implement LSTM (Long Short-Term Memory) neural network for dynamic allocation.
- Consider transaction costs and volatility targeting.

5. Performance Evaluation

- Backtest both traditional and deep learning strategies.
- Metrics : Sharpe Ratio, Annualized Return, Sortino Ratio, Max Drawdown, Win Rate, Profit/Loss Ratio

Data Used

- Historical OHLCV data for ETFs and indices from Yahoo Finance.
- Collected using the **yfinance** Python library.

Tools & Libraries

- **Programming :** Python
- **Data Handling :** Pandas, NumPy
- **Visualization :** Matplotlib, Seaborn
- **ML/Stats :** Scikit-learn
- **Deep Learning :** TensorFlow (LSTM)
- **Data API :** yfinance
- **Development :** Jupyter Notebook

Expected Outcomes

1. **Dynamic Asset Allocation :** Model-based adaptive allocation based on learned market patterns.
2. **Performance Comparison :** Deep learning vs fixed strategy portfolios.
3. **Risk-Adjusted Results :** Sharpe ratio optimization and volatility-aware allocations.
4. **Insightful Visualizations :** Seaborn-powered analysis of return distributions and correlations.