<u>Project Roadmap</u>

Objective

Develop a robust LLM based platform to recommend an optimal stock portfolio across multiple sectors, based on user inputs.

Example Input

To process and extract structured data from free-form user input (e.g., “I want a portfolio with 10% return and low risk in the technology and healthcare sectors”).

Expected Output

For a user query like the one above, the LLM processes it and provides a structured JSON-like response with all the necessary preferences:


```
{
  "expected_return": 0.10,
  "risk_tolerance": "medium",
  "time_frame": "5 years",
  "sector_preferences": ["Tech", "Healthcare"]
}
```


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1. Tech Stack

- **Programming Language:** Python, reactJS
- **Libraries:**

- **Data Analysis:** Pandas, NumPy
- **Optimization:** SciPy, PyPortfolioOpt, Markowitz Modern Portfolio Theory (MPT)
- **Visualization:** Matplotlib, Seaborn

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2. Data Source(s)

- Yahoo Finance, Alpha Vantage and Quandl

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3. Data Preprocessing

- Retrieved the stock price data over the required period.
- Calculated daily returns and covariance matrix for portfolio optimization.

The main idea for this step, was to fetch the adjusted closing prices and calculates the daily returns of each stock. The covariance matrix is then used for portfolio optimization to determine the relationship between the returns of different stocks.

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4. Portfolio Optimization

This step utilizes Markowitz Modern Portfolio Theory (MPT) to calculate the optimal weights for each stock in the portfolio by minimizing the negative Sharpe ratio and thus maximize the portfolio's Sharpe ratio (return-to-risk ratio) while ensuring that the portfolio's total weight sums to 1 (i.e., all capital is invested). It takes Stock returns (mean), covariance matrix, and risk-free rate as inputs to calculate the optimal weights for each stock.

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5. Metrics and Output Generation

Calculated the following key metrics:

- **Expected Return:** The weighted average return of the stocks**.**
- **Risk (Standard Deviation):** The portfolio's overall risk, considering the covariance between stocks.
- **Sharpe Ratio:** A measure of risk-adjusted return.

Apart from that, a user-friendly visualization was made to display the portfolio's allocation and efficient frontier (risk-return trade-off).
as inputs to calculate the optimal weights for each stock.

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6. Key Considerations:

A. Diversification Constraints

1. **Sector Limits**:
    - Example: No more than 40% of the portfolio in a single sector.
    - Example: At least 10% allocation to underrepresented sectors.
2. **Stock Limits**:
    - Example: A single stock cannot exceed 15% of the portfolio.
3. **Region or Asset Class Limits** (if applicable):

    - Ensure exposure across geographies or asset types.

Incorporating Diversification Constraints:

- Add constraints to the optimization process to enforce allocation limits.

B. **Tax Scenarios**

1. **Capital Gains Tax**:
    - **Short-term capital gains**: Higher tax rate (e.g., 30%).
    - **Long-term capital gains**: Lower tax rate (e.g., 15%).
2. **Dividend Tax**:
    - Dividends can also be taxed at different rates depending on the jurisdiction.

Incorporating Taxes in Portfolio Optimization:

- Adjust the expected return of each stock based on potential tax liabilities.
- Reduce the effective return of dividend-paying stocks.