Project Proposal: Portfolio Optimization using Artificial Intelligence

Objective: Building an AI agent that is capable of performing Stock Portfolio Optimization using reinforcement learning.

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Background:
Portfolio optimization is the process of choosing the proportions of various assets to be held in a portfolio, in such a way as to make the portfolio better than any other according to some criterion. The criterion will combine the expected value of the portfolio's rate of return as well as some other measures of financial risk.

The portfolio optimization problem is generally specified as a constrained utility-maximization problem. Although portfolio utility functions can take many forms, common formulations define it as the expected portfolio return (net of transaction and financing costs) minus a cost of risk.

The cost of risk is defined as the portfolio risk multiplied by a risk aversion parameter (or unit price of risk). Practitioners often add additional constraints to improve diversification and further limit risk. Examples of such constraints are asset, sector, and region portfolio weight limits.

Implementation:
We plan on using reinforcement learning and train the agent over a period of time say, 2 years. We will account for daily prices of stocks in contrast to intraday prices as the former is more relevant for portfolio optimization.

We will be monitoring a specific number of stocks (eg. 100) from either NASDAQ or S&P 500.

We will further categorize stocks as Blue-chip, Income, Cyclical, Defensive, Growth, Tech, Speculative. We can then, assign a policy to the portfolio according to the amount of risk specified. We will limit to the following portfolio policies: Aggressive, Defensive, Income or Speculative.

Working:
The user will provide us with a portfolio i.e. some stocks with current allocation percentage. Our task is to optimize the portfolio according to the risk specified by the user. Our agent will learn about stocks (perform reinforcement learning) from data and provide optimized allocation percentage for each stock.

Technologies:
We will implement the project in Python. We will also experiment with machine learning libraries in python such as tensorflow, sklearn etc.

References:
[1] https://en.wikipedia.org/wiki/Portfolio_optimization
[2] https://www.investopedia.com/university/simulator/diversified-portfolio.asp
[3] https://www.investopedia.com/articles/basics/11/5-popular-portfolio-types.asp