- a_1: **Buy/Sell/Hold the current assets**, making decisions on whether to acquire new assets, divest existing ones, or maintain the current position;

- a_2: **Adjust the quantity and price of securities to be bought or sold**, fine-tuning the volume and pricing strategy for securities transactions;

- a_3: **Set or modify trading stop-loss, take-profit, and other trading strategy conditions**, implementing or revising parameters for automated trading strategies to manage risk and lock in profits;

- a_4: **Adjust the risk exposure of the investment portfolio**, allocating budget weights and modifying the portfolio to achieve the desired level of risk exposure;

- a_5: **Execute Asset Allocation**, strategically distributing investment capital across various asset classes to optimize the portfolio's risk and return profile;

- a_6: **Enforce Compliance with Regulatory Standards**, ensuring that all investment activities adhere to the legal and regulatory framework governing financial markets;

- a_7: **Rebalance Portfolio**, adjusting the portfolio to maintain the desired asset allocation and risk profile in response to market changes;

- a_8: **Conduct Market Scanning**, continuously monitoring the market for new investment opportunities and potential risks;

- a_9: **Initiate Hedging Strategies**, implementing hedging techniques such as derivatives to protect the portfolio against adverse market movements;

- a_{10}: **Generate Financial Reports**, producing detailed reports on portfolio performance, risk exposure, and compliance status for internal and external stakeholders.

B.3 Memory

For an agent the Memory module $\mathcal{M}$ is designed to store and manage three main types of information:

- **Market Information Memory** ($\mathcal{MI}$). This memory component stores historical data, including stock prices, financial news, and economic indicators, all of which are relevant to the investment decisions made by the agents.

- **Strategy Memory** ($\mathcal{MS}$). This memory component contains a comprehensive analysis of strategies employed in both simulated trading environments and real-world trading scenarios, allowing the agents to refine their approaches based on past performance.

- **Report Memory** ($\mathcal{M}_R$). This memory component comprises in-depth analyses of markets, industries, and companies, serving as a reference for the agents when generating investment reports and making informed decisions.

B.4 Profile

The profile module provides a comprehensive specification of an agent's identity, responsibilities, and operational boundaries, ensuring a well-structured and controlled environment for intelligent investment decision-making. The agent's Profile includes the following main components:

- **Basic Information**: This encompasses the agent type, background information and role assignments.

- **Action Permissions**: The set of actions that the agent is authorized to perform.

- **Tool Permissions**: The collection of analytical tools and resources accessible to the agent for decision-making.

- **Market Information Permissions**: The scope of market data and news that the agent is allowed to access.

- **Team Background**: Provides an overview of the team's structure, the agents' collaborative roles, and the collective goals within the QuantAgents framework.

B.5 Reflection

The reflection process represents the core decision-making component of the agent. It leverages the LLM foundation to analyze the input information and generate a reflective output based on the specific task objective. Let $\mathcal{I}_t$ denote the set of inputs available to the agent at time t. The reflection process can be formulated as:

$$R_t^\gamma = \mathcal{R}(\gamma, \mathcal{I}_t) \tag{7}$$

Where $\mathcal{R}(\cdot)$ represents reflection function, γ represents the current reflective task. The output R_t^γ is the agent's reflection at time t.

The reflection process can be further decomposed into multiple stages, representing the agent's thought process: i) Information Preprocessing: The agent filters and organizes the input information $\mathcal{I}_t$ based on relevance and importance; ii)Context Understanding: The agent analyzes the preprocessed information to develop a comprehensive understanding of the current market context; iii)Goal Alignment: The agent aligns its analysis with the specific investment objectives and constraints defined in its Profile; iv)Strategy Formulation: Based on the context understanding and goal alignment, the agent formulates potential investment strategies and evaluates their risks and rewards; v)Decision Making: The agent selects the most suitable strategy, considering its accumulated experience, and generates the final Reflection output R_t^γ. The Reflection process is iterative and continuously updated as new information becomes available, enabling the agents to adapt their investment decisions dynamically in response to changing market conditions.

C Prompt Templates for Various Tasks

In this section, we detail the prompt templates used for various tasks within the QuantAgents framework. These templates are essential for guiding the Large Language Model (LLM) to generate accurate and context-specific outputs, supporting the decision-making processes of different agents.

- **Market Analysis:** For tasks related to market analysis, the prompt template focuses on delivering a comprehensive evaluation of current market conditions, including key financial indicators and recent news. An example template is:

  > <Prompt Template>
  > You are {Emily Profile}, a Market Analyst. Today's market overview includes the following data: {Current Prices}, {Recent News}. Utilize the available financial analysis tools to generate insights. Present the results in JSON format, including key metrics such as {Tool Results}.

- **Strategy Development:** For strategy development tasks, the prompt template is designed to capture detailed information about strategy formulation and performance evaluation. An example template is:

  > <Prompt Template>
  > You are {Bob Profile}, a Strategy Analyst. The current strategy is defined by {Strategy Parameters}, and the simulation results are as follows: {Simulation Data}. Optimize the strategy to enhance {Performance Metrics} and provide recommendations in JSON format, highlighting areas for improvement.

- **Risk Management:** For risk management tasks, the prompt template emphasizes the assessment and mitigation of financial risks. An example template is:

  > <Prompt Template>
  > You are {Dave Profile}, a Risk Analyst. Current risk metrics include {Risk Indicators}, and recent risk events are {Risk Events}. Evaluate the overall risk exposure and propose effective risk mitigation strategies. Output should be in JSON format, with detailed recommendations for risk management.

- **Investment Decision:** For investment decision tasks, the prompt template is designed to guide the evaluation of potential investment opportunities based on market conditions and strategic objectives. An example template is:

  > <Prompt Template>
  > You are {Otto Profile}, an Investment Manager. Evaluate the following investment opportunities: {Investment Options}. Considering the current market data {Market Data}, determine the optimal investment strategy and provide a JSON-formatted recommendation outlining the suggested actions.

D Profiles of Agents

This appendix provides an exhaustive outline of the QuantAgents team member profiles, which are integral to our investment decision-making simulation. The profiles are articulated using XML, chosen for its flexibility and robustness in structuring and representing complex data. XML's self-descriptive nature and the ability to define custom tags make it an ideal choice for encoding the intricate details of each agent's profile. It

allows for a high degree of customization and scalability, which is essential for simulating a dynamic and complex environment such as a hedge fund's investment strategy.

E Construction of the Strategy Pool

This section elaborates on the methodology employed for constructing the strategy pool, referenced in the Strategy Development Meeting section. The strategy pool is pivotal for evaluating and refining trading strategies within the QuantAgents framework.

- **Strategy Pool Definition:** The strategy pool encompasses a diverse array of trading strategies derived from permutations of various indices and parameters. This comprehensive array ensures a broad exploration of potential strategies, facilitating the identification of those most effective under varying market conditions.

- **Permutations of Indices and Parameters:** The construction of the strategy pool involves generating permutations across multiple indices and trading parameters. Each permutation represents a unique combination of factors such as technical indicators, risk management rules, and trading signals. This methodology enables a thorough evaluation of strategies across different market environments.

- **Data Utilization:** Historical and real-time market data form the basis for simulating the performance of each strategy within the pool. This data includes stock prices, trading volumes, economic indicators, and other pertinent financial metrics. By applying strategies to this data, we assess their effectiveness and make informed decisions regarding their potential deployment.

- **Performance Evaluation and Selection:** Strategies within the pool are rigorously evaluated based on key performance metrics, including return on investment (ROI), risk-adjusted returns, and maximum drawdown. Strategies demonstrating superior performance metrics are selected for further testing and refinement. This evaluation ensures that only the most promising strategies advance to the subsequent stages of development.

- **Dynamic Updates:** The strategy pool is subject to continuous updates based on new market data and performance feedback. This adaptive approach ensures that the pool remains relevant and responsive to evolving market conditions, integrating new insights and methodologies into strategy development.

The strategic construction and maintenance of the strategy pool are crucial for the effective functioning of the QuantAgents framework.

F PRUDEX Evaluation Benchmark

PRUDEX-Compass is a systematic evaluation framework for methods in financial markets, consisting of six axes with a total of 17 measures. Each axis represents a critical aspect of the evaluation, and the measures provide detailed insights into the performance of the methods across these aspects. The following is PRUDEX's specific explanation of the dimensions it assesses.

Profitability. In line with the primary goal of Quantitative Trading (QT) to maximize profits, this criterion assesses the capacity of Financial Reinforcement Learning (FinRL) methods to accumulate market capital. It extends beyond mere returns to encompass the stability and consistency of strategies in achieving substantial profits.

Risk-Control. Given the inherent trade-off between profitability and risk in financial contexts, this element is pivotal. It reflects the industry's emphasis on managing both systemic and unsystematic risks, which is crucial for FinRL method evaluation.

Universality. The financial market's complexity, with its myriad assets and varying temporal and stylistic dimensions, poses a challenge. This criterion evaluates the versatility of FinRL methods in delivering satisfactory performance across diverse trading environments. It aligns with contemporary machine learning trends, such as transfer and meta-learning.

Diversity. Financial diversification, a strategy to spread capital across different assets to mitigate risk, is highlighted by this axis. It addresses the current oversight in FinRL method evaluation concerning diversity, which is essential for bolstering profitability and managing risk.

Reliability. The performance variability of RL methods, their sensitivity to various factors, including random seeds and market fluctuations, can impede reliability—critical for high-stakes