**Enhancing Asset Purchase Compliance through AI-Driven Analysis**

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**Introduction**

Regulatory compliance is one of the most important pillars for the success and sustainability of investment funds. In Brazil, regulations imposed by the Securities and Exchange Commission (CVM), such as Resolution 175, set strict guidelines that must be followed to ensure that funds purchase only permitted assets. However, interpreting and applying these rules can be complex and prone to human error, especially when applied to many assets and funds.

With the advancement of Artificial Intelligence (AI) and the availability of highly sophisticated language models, there is an opportunity to automate and enhance the compliance verification process. This work presents an innovative solution to automate compliance analysis in the asset purchase process for investment funds, using AI to interpret regulations and fund prospectuses.

**Project Overview**

The primary goal of this project is to create an automated system capable of determining whether a mutual fund can legally purchase a specific asset, in accordance with Brazilian financial regulations. This system leverages a range of advanced AI models and tools to meticulously analyze regulatory documents, fund prospectuses, and asset data. By integrating these technologies, the system aims to provide a thorough and accurate compliance assessment, ensuring that investment decisions are made with full adherence to regulatory standards. The project combines state-of-the-art natural language processing models with specialized tools to handle complex legal and financial information, thus enhancing the efficiency and reliability of the compliance verification process.

**Tests and Execution**

Tests were conducted using a database of real assets and funds. For each combination of fund and asset, the system was executed in four different modes:

* **Simple Prompt:** Using the GPT-4 model to generate responses directly.
* **Agents Without Specific Tools:** Utilizing agents without additional research resources.
* **Agents with Specific Tools:** Integrating specific tools such as regulation search and PDF reading.
* **RAG:** Implementing the RAG method to augment the model’s responses by retrieving relevant regulatory information from external databases before generating the final output. This approach aimed to improve accuracy by providing contextually rich data to the model.

The results were stored in an Excel file, allowing for a comparative analysis of the performance of each approach.

**Time Performance Evaluation**

The time performance of each method was systematically evaluated by calculating the average execution time over six consecutive days, with timing recorded using the *time.monotonic()* function.

Tabela

Descrição gerada automaticamente

The findings highlight a clear trade-off between the simplicity and speed of the Simple Prompt method and the enhanced capabilities, albeit at the cost of longer execution times, of the more complex methods such as Agent With Tools and RAG. While Simple Prompt is optimal for scenarios requiring rapid and straightforward responses, the other methods, despite their slower processing times, demonstrate a larger capacity in extracting and synthesizing information from a broader array of external sources.

**Results and Observations**

We evaluated the accuracy of the model on six different dates and several key points were identified:

* **Regulatory Capture Ability:** The model demonstrated a rather generalist approach in capturing Brazilian regulations and fund prospectus, even when these sources were integrated as tools and research references.
* **Impact of the "Shelter" Name**: The name "Shelter" in the name of the funds EQUITAS SHELTER and DRYS SHELTER PREV had a significant impact on the results. In almost all instances, none of the models tested were able to correctly identify the associated fund, even when the corresponding prospectus was included.
* **Hallucinations and Response Variations:** Numerous instances of hallucinations were observed throughout the tests, even within the same model. The responses exhibited considerable variations, as seen in the interpretation of terms like "stocks" versus "PETR4." Additionally, the system produced erroneous answers, such as when asked if DRYS SHELTER PREV could purchase “Compromissadas.” The model incorrectly responded, “No, DRYS SHELTER PREV cannot purchase Compromissadas. According to the fund's investment guidelines, it is restricted to investing in low-barrier shelters for cattle and Dry Deck Shelters (DDS) for US Navy submarines.”
* **Costs:** The cost analysis highlights significant variations in the financial resources needed to run 20 executions per model. The Simple Prompt method is the most cost-effective at $0.03 and the fastest. However, as the complexity of the methods increases, so does the cost. For example, the Agent No Tools method costs $1.38 due to higher computational demands. The RAG models, which incorporate external information sources, range from $0.20 to $1.03, offering a balance between cost and the comprehensiveness of data captured.

Below are the accuracy percentages of the models evaluated on different dates.

Tabela

Descrição gerada automaticamente

We noticed that the funds TREND DI, a fixed-income fund, and EQUITAS SELECTION, a well-known equity fund. These funds yielded the most consistent results across the evaluations.

During the evaluation period, we thoroughly examined the reasoning behind each response generated by the models. On average, the accuracy of the responses was below 50%, despite the provision of regulatory tools and specific investment fund regulations. This outcome reveals substantial difficulties that the models encounter in interpreting Brazilian investment fund regulations and understanding the characteristics of the tested assets relative to the American market. The analysis highlights the complexities involved in applying AI to the Brazilian regulatory environment, where local legislation and market conditions present significant challenges that current models have yet to fully grasp.

**Conclusion**

The AI-driven compliance system represents a notable advancement in ensuring regulatory adherence for mutual fund asset purchases. By incorporating state-of-the-art tools and advanced AI models, the system enhances the precision of compliance assessments and streamlines the process, making it more efficient. This progress signifies a major step forward in automating complex regulatory evaluations, which previously demanded extensive manual effort.

Looking ahead, future developments will focus on refining the AI models and expanding the system’s capabilities to address additional regulatory scenarios and incorporate more nuanced aspects of compliance. These improvements aim to ensure that the system remains at the forefront of regulatory technology, continuously enhancing its effectiveness in navigating the evolving landscape of financial regulations.