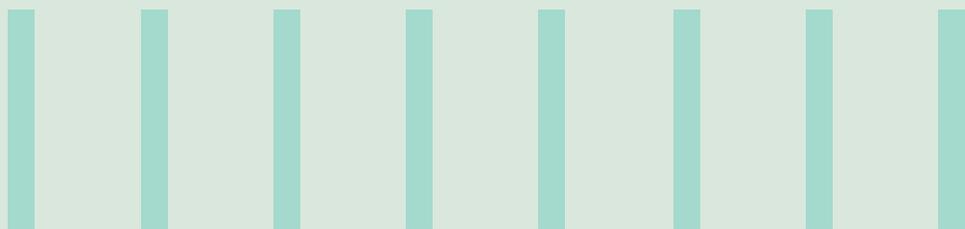




HARNESSING GENAI AND ML TO DRIVE THE FUTURE OF MORTGAGE LOAN ORIGINATION



Insights:

- GenAI and ML hold transformative potential for mortgage origination, increasing efficiency and regulatory compliance.
- Case studies like Apple's credit card reveal the importance of having a framework integrating AI risk management and fairness checks in high-stakes lending decisions using AI models.
- An AI framework that supports diverse stakeholders, encapsulates risk management, and understands the mortgage domain can help businesses accelerate their lending business operations.

Navigating the intricate landscape of the mortgage industry comes with its set of challenges, primarily due to heavy regulation and the complexities of assessing credit risk. Ensuring compliance with evolving regulations can be complex and costly, coupled with the implications of legal penalties and reputational harm for those who fail to adhere.

Additionally, the accurate assessment of credit risk remains a critical challenge as traditional models often fail to look through emerging factors, exposing lenders to potential defaults and financial losses. To make matters worse, the lending and credit decision process is complex and heavily regulated, encompassing three primary components, i.e., 1) acquiring customer information, 2) evaluating credit risk and decisioning, and 3) reporting, documenting, and clarifying the decision factors for stakeholders. The business ops for these steps are labor-intensive, requiring domain experts to perform multiple (Standard Operating Procedures) SOPs for each credit scenario separately.

So, *what is the remedy here?*

In this context, an AI-powered mortgage origination system that improves efficiency, accuracy, and compliance is needed. An AI framework that supports diverse stakeholders, encapsulates risk management, and understands the mortgage domain can help businesses accelerate their lending business operations.

Rethinking Mortgage with GenAI and ML

According to the Fannie Mae Mortgage Lender Sentiment Survey released in October 2023, only 7% of mortgage lenders currently use advanced AI technologies, while 71% are either just beginning to explore GenAI technology or are not considering it at.

Despite the findings of the Fannie Mae survey, GenAI and deep learning's potential to revolutionize credit risk underwriting remains strong. With the proper deployment of GenAI and ML technologies, lenders can improve precision, streamline operations, and strengthen risk management in their decision-making processes.

However, the industry's cautious stance, which is likely influenced by regulatory hurdles and the complexities of underwriting, has restricted the widespread adoption of AI in mortgage underwriting.

This slow integration can be traced back to several challenges, including the need for stringent model validation and the absence of a robust regulatory framework for AI-based models, which often requires additional scrutiny and compliance efforts. Consequently, this regulatory uncertainty could be a significant factor discouraging lenders from fully embracing AI-driven solutions.

As a result, despite the integration of GenAI and deep learning in disciplines such as customer service and marketing, the domain of credit risk underwriting continues to favor traditional methods such as Probability-of-Default (PD) and Loss-Given-Default (LGD).

Further to this, let's explore a well-known real-world case study where the integration of AI and GenAI-based models failed miserably, making lenders more apprehensive about adopting advanced methods in their business operations.



Case study: Apple Credit Card

In 2019, Apple launched its credit card managed by Goldman Sachs which used advanced AI models for underwriting. However, it was soon discovered that women were given significantly lower credit limits compared to their male counterparts, even when they had better financial histories. Goldman Sachs consequently [faced an investigation](#) by the New York Department of Financial Services (NYDFS) on anti-discrimination law violations.

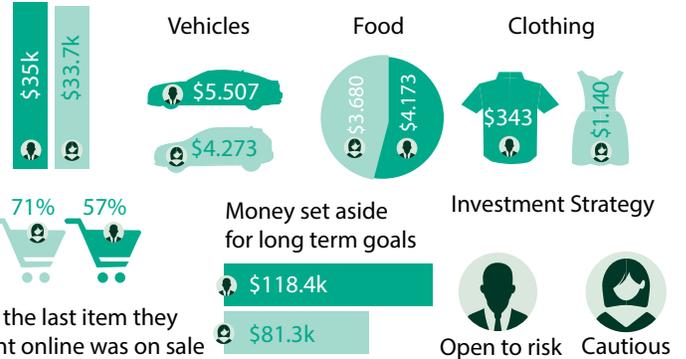
In this case, while there was no direct inclusion of gender as a model feature, the indirect correlation with factors like the type

of purchases and spending patterns (refer to Image 1) led to discriminatory outcomes. This unintentionally amplifies bias in data, however indirect and subtle. Since the model was complex and used a lot of historical data to train, it led to replicating societal biases.

Even after the bias was discovered, it was very hard to debug and pinpoint issues with the model and fix them due to the complex architecture of the model. Hence, it is extremely critical to examine all considerations when suggesting/ planning/ designing complex AI-based models in mortgage and lending business processes.

CREDIT CARD STATEMENT						
STATEMENTS		TAX	COUNT	STATEMENT PERIOD	DU	
Fashion Hub	STY	1.00	1.00	\$1.00	1.00	\$1.00
Fashion Hub	STY	1.00	1.00	\$1.00	1.00	\$1.00
Fresh Mart	STY	1.00	1.00	\$1.00	1.00	\$1.00
Fresh Mart	STY	1.00	1.00	\$1.00	1.00	\$1.00
Dining Cafe	STY	1.00	1.00	\$1.00	1.00	\$1.00
Auto Care	STY	1.00	1.00	\$1.00	1.00	\$1.00

Overall spent



ACCOUNT ACTIVITY

Post Date	Trans Date	Reference Number	Merchant Name or Description
MM/DD	MM/DD	XXXX	PAYMENTS AND OTHER CREDITS
MM/DD	MM/DD	XXXX	PAYMENT - THANK YOU
MM/DD	MM/DD	XXXX	PURCHASES
MM/DD	MM/DD	XXXX	Kawasaki Z87 001
MM/DD	MM/DD	XXXX	Hard Rock Cafe G45
MM/DD	MM/DD	XXXX	EWX Football entry ticket
MM/DD	MM/DD	XXXX	Spac Retail

Image 1: Type of purchases and spending pattern



However, keeping the exceptions aside, there is a pressing need for implementing a framework to modernize the mortgage industry which can help improve compliance, efficiency, and customer satisfaction while minimizing risks associated with the implementation of credit assessment models.

The AI Mortgage Flow Framework

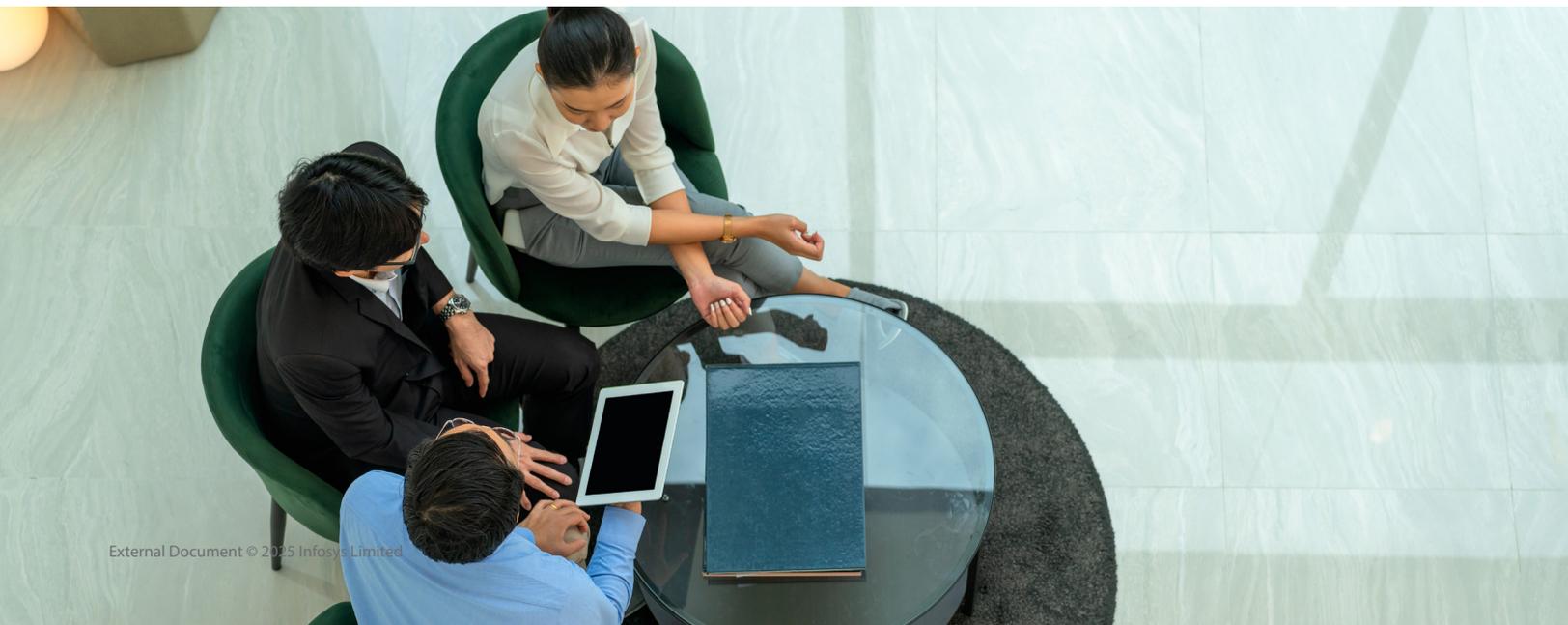
AI Mortgage Flow leverages artificial intelligence (AI) to streamline and enhance the mortgage process. This framework offers a structured, high-level approach that assimilates both structured

and unstructured data, improving loan officers' efficiency, while enhancing customer and employee experiences. Additionally, this framework also incorporates various controls for measuring potential biases within AI models, ensuring a transparent decision-making process in mortgage lending.

The proposed AI-driven mortgage loan origination system integrates four key capabilities of this framework as outlined below.



Image 2- AI-driven mortgage loan origination system





1. Knowledge Agent

In a digitally interconnected landscape, data should be strategically leveraged from all sources, including internal bank data (especially for existing customers), external inputs from credit bureaus, financial information providers (such as Bloomberg, Refinitiv, and Moody's), along with unstructured data sources like social media, mobile data, and alternative financial transaction records.

The Knowledge Agent gathers this data from various sources/formats (leveraging OCR, scrapping, transformation, etc.) to create a single view for other agents to perform calculations and downstream analytics. It also encapsulates a domain-specific ontology for efficient processing of mortgage taxonomy, and an inbuilt language neutralizer to effectively process a variety of data from various linguistic sources.

The primary role of the Knowledge Agent is to compile and build a single view of an entity of interest (like Customer 360° or Collateral 360°). But, it may also include the identification of data bias and cleanup activities on a case-to-case basis. Identifying various forms of data biases, including historical bias, selection bias, demographic parity, equal opportunity, etc., needs careful consideration of tools and keeping human oversight in the loop to decide on the fix (resampling, fair representations, regularization, etc.) that will result in a more accurate and unbiased knowledge repository.

2. Risk Agent

Credit assessment and collateral underwriting is a complex process that requires analysis, evaluation, and assessment of client/ collateral before any final decision-making. Risk Agent serves as a virtual assistant to the mortgage officer, providing all computed calculations, aggregated insights, and relevant source documents for traceability. The final decision can then be made by a human.

While the agent can perform operations including the calculation of underwriting metrics like credit scores, debt-to-income ratios (DTI), loan-to-value ratios (LTV), etc., the final acceptance needs to be done by authorized personnel. Scenarios that require special approvals and exceptions would also have to be authorized by humans, while the Risk Agent can create multiple what-if scenarios and provide quantitative consequences of the same. Additionally, it can also help in stress testing and scenario analysis on specific mortgage sections or entire portfolios, as well as advising on contingency measures like revisiting underwriting practices or adjusting capital liquidity, to manage identified risks proactively.

3. Fairness Agent

The Financial Services industry is increasingly focused on ethical AI and fair lending practices, given the risks of discrimination and regulatory non-compliance. Stringent norms in certain countries like the Equal Credit Opportunity Act (ECOA) in the U.S. prohibit

the use of certain personal characteristics (e.g., race, gender, marital status, religion, demographics) in credit decision-making, be it directly or through indirect data proxies. Besides, recent regulations like the EU AI Act and guidelines from The U.S. Federal Reserve also demand the interpretability and explainability of models along with regular auditing of models to uphold these standards.

The Fairness Agent helps with auditing and profiling models in terms of fairness, assessing key factors like explainability, algorithmic bias, rejection inference, proxy feature analysis, etc. The risk office would then have to carefully study the fairness versus performance tradeoff and select the models, acknowledging the risks of using complex and opaque models with higher statistical accuracy versus the simpler and explainable rule-based heuristics.

4. Insights Agent

Apart from the focus on specific and clearer responsibilities, there is also a requirement for a broader interface which can help with multiple modes of information engineering. The Insights Agent serves as an integrated platform, grounded in Human-Computer Interaction (HCI) principles, making data more usable, efficient, and accessible for various stakeholders like risk officers, senior management, and auditors. They can use this agent to access information through a natural language interface like a chatbot, augmented BI, a content generator, and policy Q&A.

While the risk officer can ask an Insight Agent to draft the final communication to the customer providing the justification and reasoning for acceptance or rejection, a senior executive may wish to see dashboards on liquidity risk and “what-if” scenarios. The Insights Agent helps with this using a GenAI platform that provides the extracted results in a natural, multilingual format, supported by graphs or images for infographics.





The Way Forward

The multi-agent framework presented here is designed to holistically transform the business processes in the mortgage industry. It helps balance the incorporation of new technology into the lending process with existing ones, making sure that the fair use of AI is maintained and reputational risks are avoided. Implementing the AI mortgage flow framework can help organizations avoid the challenges that were encountered

by Apple and Goldman Sachs. It will accelerate the building of a compound AI system within the mortgage line of business in the bank, highlighting all the risks before the final deployment of models, while creating awareness of how customer data is getting processed within the credit decision pipeline. Ultimately, this comprehensive and end-to-end systematic framework enables a resilient, and adaptive mortgage lending structure that can alter according to regulatory demands, while creating long-term customer trust through ethical AI practices.

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