AI-Endgame: Practical Applications of Artificial Intelligence in Lending

by

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Introduction

Great strides have been made in the development and application of artificial intelligence (AI) in the last few years. We now see so many striking examples of applications of AI in our day-to-day life, such as checkout-less Amazon Go stores, cars with autonomous driving becoming commonplace, accurate, personalized product recommendations, and more. AI is more present than ever, and its application in the consumer space is growing rapidly.

Despite these advances in AI, the adoption of AI in the mortgage industry is fairly low at the time of this paper's publication. There are questions about how AI can successfully be applied in this industry for business gains and improved outcomes. This white paper explains various key aspects of AI to be considered, where AI has significant promise for the lending industry, and how Tavant is leveraging these technologies to help mortgage professionals.

A Brief Overview of AI

Artificial intelligence, broadly speaking, can be defined as machines demonstrating behavior that requires human-like intelligence. Machine learning (ML) techniques are a subset of AI, and the often-heard term Deep Learning is a category of techniques within Machine Learning.

Machine learning refers to a subset of AI techniques based on learning from data, typically, from large amounts of data. For a given objective, machine learning looks for patterns in the data it's given and tries to find a mapping from the data fields to the output for that objective. Its goal is to extract that knowledge to use within the ML model to predict what the outcome should be for a given data point. For instance, for the objective of minimizing churn among borrowers, ML can be utilized to predict the probability of early payoffs given the loan origination and performance data enriched with the macroeconomic data over time. Essentially, ML extracts knowledge from data and makes inferences based on that or on any new data that's provided to the algorithm.
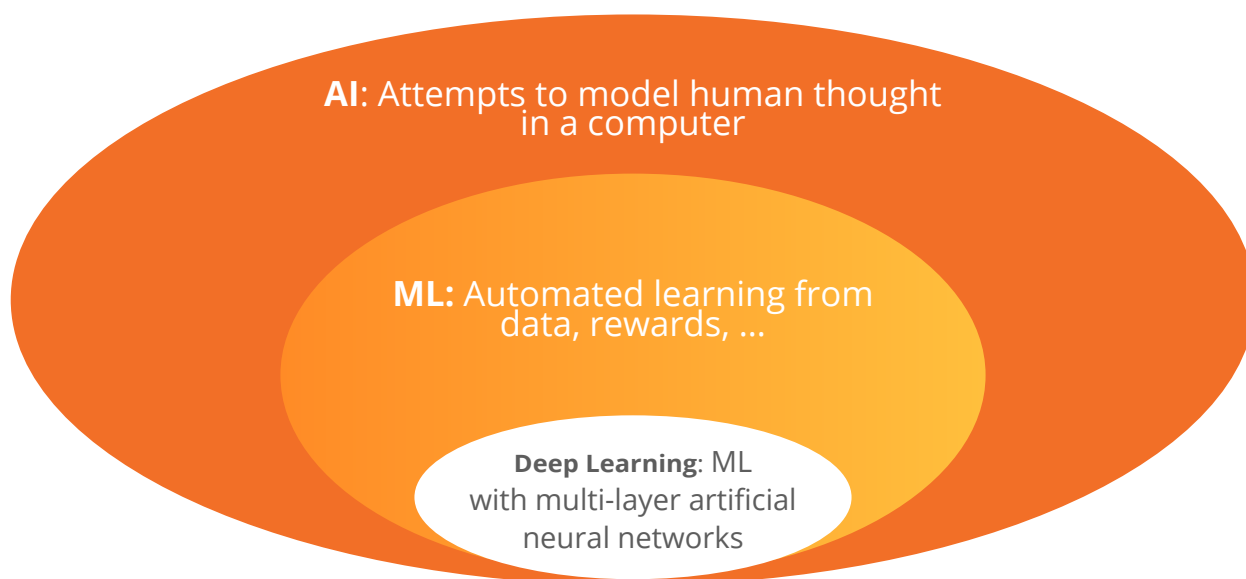
AI: Attempts to model human thought in a computer

ML: Automated learning from data, rewards, ...

Deep Learning: ML with multi-layer artificial neural networks

Figure 1: Artificial Intelligence vs Machine Learning vs Deep Learning

Within machine learning exists deep learning, which is ML that uses multi-layer artificial neural networks. Deep learning (DL), one of the most powerful techniques in the ML space today, is inspired by the functioning of the neurons in the human brain. The power of neural networks comes due to their capability to approximate any mathematical function if provided with a sufficiently large amount of data to train on. Given that in most industries, the amount of data that is being generated, neural networks can significantly outperform the more traditional methods in a large number of application use cases.
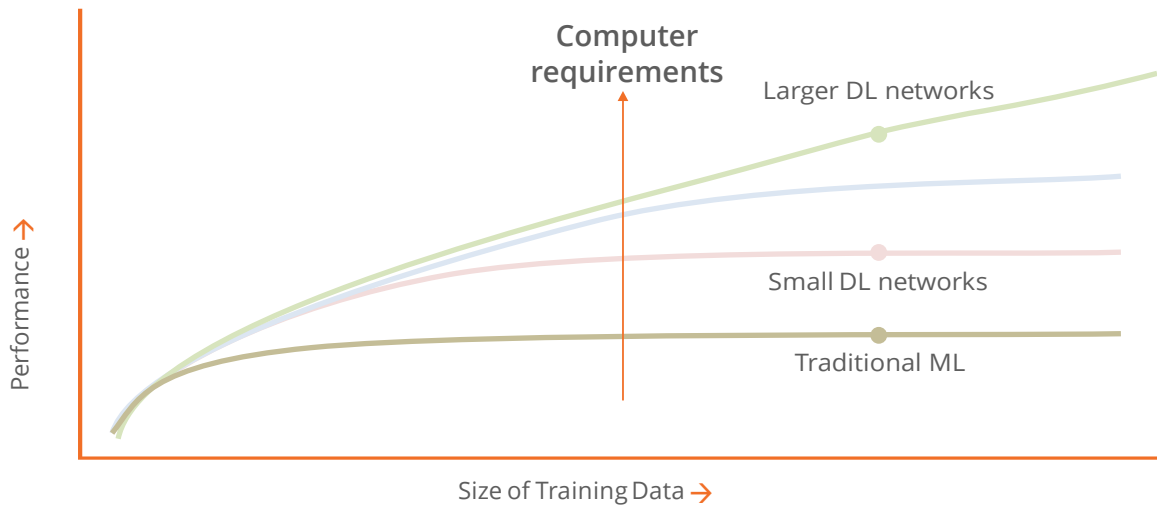
Figure 2: Deep Learning performance with size of training data

However, DL's capability for modeling complexity comes at a cost; it is not so straight forward to reason about why a DL model made the prediction that it did. If, for example, a DL model classified a loan application as a risky application, it's not easy to see directly why it was classified that way or, in other words, what parameters in the loan application led to that classification.

Having said that, there are multiple classes of methods that can help explain the reason for the predictions made by the ML models. These range from methods that identify the aggregated importance of various input data fields (features) in making the predictions, to the methods that can identify why an individual data point resulted in a specific prediction. The former is useful for making sense of the overall operation and credibility of the model, while the latter is useful to help the users make business decisions for each prediction. For instance, when a loan is classified as risky, it is useful to know the actual parameters of the loan that led to that decision and to what degree.

Opaque ML Classification Model
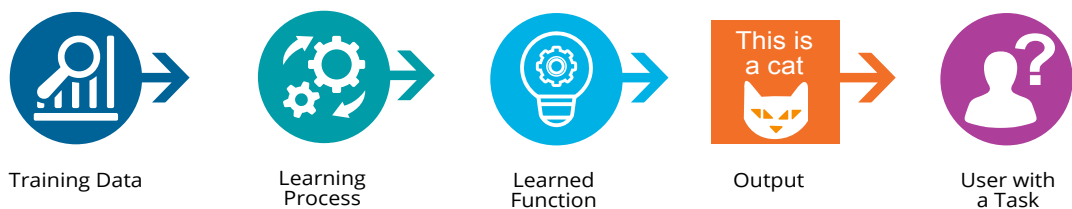
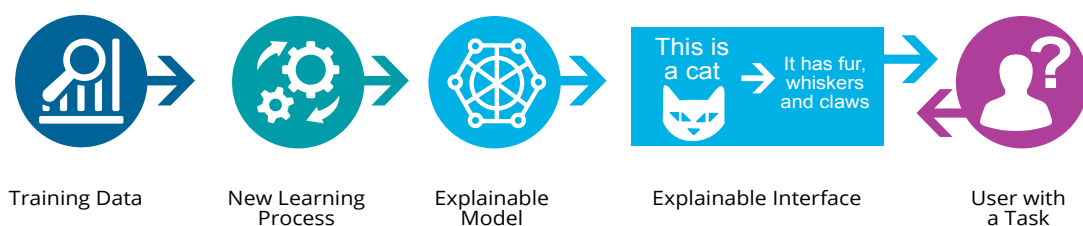**Explainable ML Classification Model**

Figure 3: Explainable AI

Applying AI Throughout the
Lending Ecosystem

Today, ML-based solutions have been proven to deliver high business value in nearly all industries; to quote Andrew Ng, a renowned AI scientist, "I actually have a hard time thinking of an industry that I don't think AI will transform in the next several years". Now it's up to the mortgage industry to adopt and leverage the power of AI to solve complex lending challenges.

Multiple areas throughout the lending ecosystem can benefit from the application of Machine Learning. AI & ML can render itself to providing a delightful customer experience, to detecting anomalies; it can help with intelligent process orchestration and provide underwriting assistance; it can help you predict conversion, churn, and default.
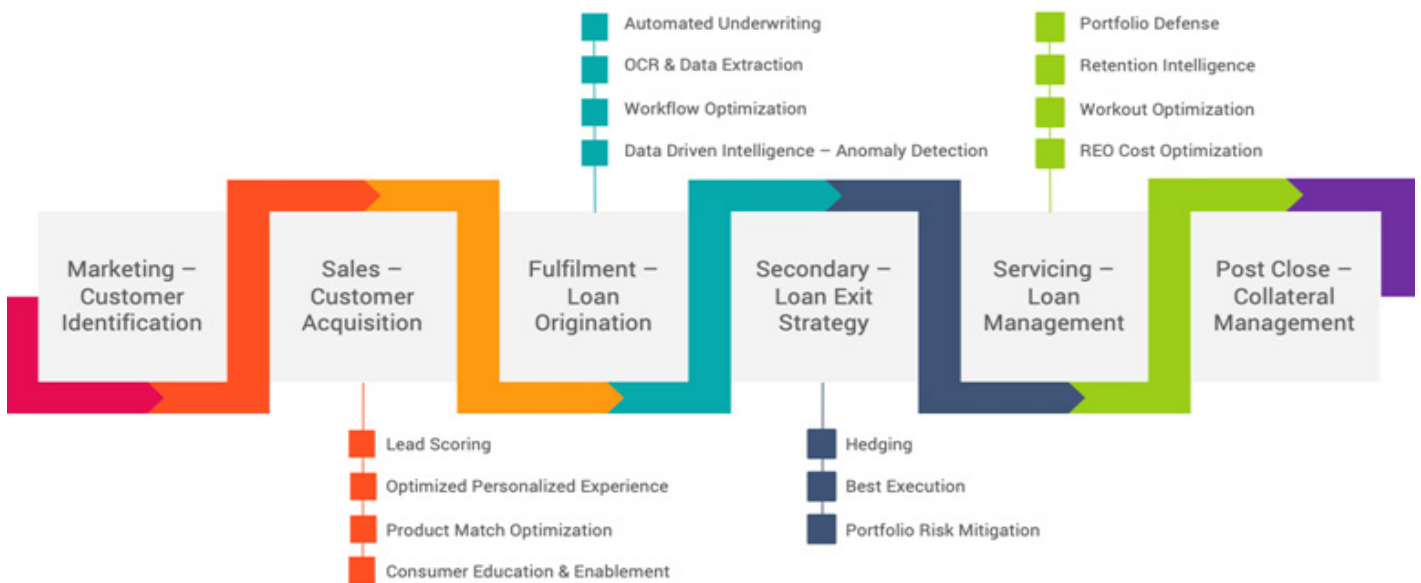

- Automated Underwriting
- OCR & Data Extraction
- Workflow Optimization
- Data Driven Intelligence – Anomaly Detection

- Portfolio Defense
- Retention Intelligence
- Workout Optimization
- REO Cost Optimization

Marketing – Customer Identification   **Sales –** Customer Acquisition   **Fulfilment –** Loan Origination   **Secondary –** Loan Exit Strategy   **Servicing –** Loan Management   **Post Close –** Collateral Management

- Lead Scoring
- Optimized Personalized Experience
- Product Match Optimization
- Consumer Education & Enablement

- Hedging
- Best Execution
- Portfolio Risk Mitigation

Figure 4: Applications of AI and ML in Lending

How Tavant is
Leveraging AI in Lending

When it comes to leveraging AI and ML in the lending space, Tavant has the benefit of 15 years' worth of data – loan origination, loan performance, payment patterns, macro-economic data, labor statistics, lending rates, house prices, income, demographics, and more ¬– that it can use as a foundation when building solutions. Tavant can supplement this valuable data with additional information to figure out precisely what borrowers and products are a good fit for one another.

Based on its research, Tavant has built out solutions, products, and services that are helping lenders and financial institutions improve their business processes, be more cost-effective, lower their cycle time, and provide a delightful experience to their borrowers. Within the Tavant VELOX Product Suite, there are multiple products taking advantage of Tavant's AI and ML models to enable differentiation for their clients. In this paper, we will talk about four such applications of AI and ML within the lending eco-system.

Conversion Propensity in Consumer Direct

As the mortgage industry notes consumers' preferences around engagement in the mortgage process, there are questions about consumer behavior; how to take the consumer further along in the journey and pull them through the application process. Tavant leverages a combination of design thinking and outcome from its ML models to help its clients deliver intuitive mortgage interactions to their consumers.

Tavant's FinXperience product creates a large amount of metadata from consumer behavior and interaction through the mortgage application journey – for example, questions answered, questions skipped, application dropped or abandoned, number of sessions required to complete the application, number of digital data services leveraged, types of devices used in the process, geographic location, age ranges and more. Tavant anonymizes and aggregates this data across all borrowers and supplements this data with consumers' demographic and psychographic data and feeds that data back into the ML model.

The ML model feeds its recommendation into the FinXperience product's navigation engine. The navigation engine is based on a dynamic decision tree that consumes the recommendation and creates personalized journeys for different borrower personas. The model is currently being tested in Tavant's product innovation lab and is undergoing usability testing with Tavant's alpha test user group. Initial test results have been positive – indicating up to 25% improvement in borrower conversion.

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Underwriting Assistant
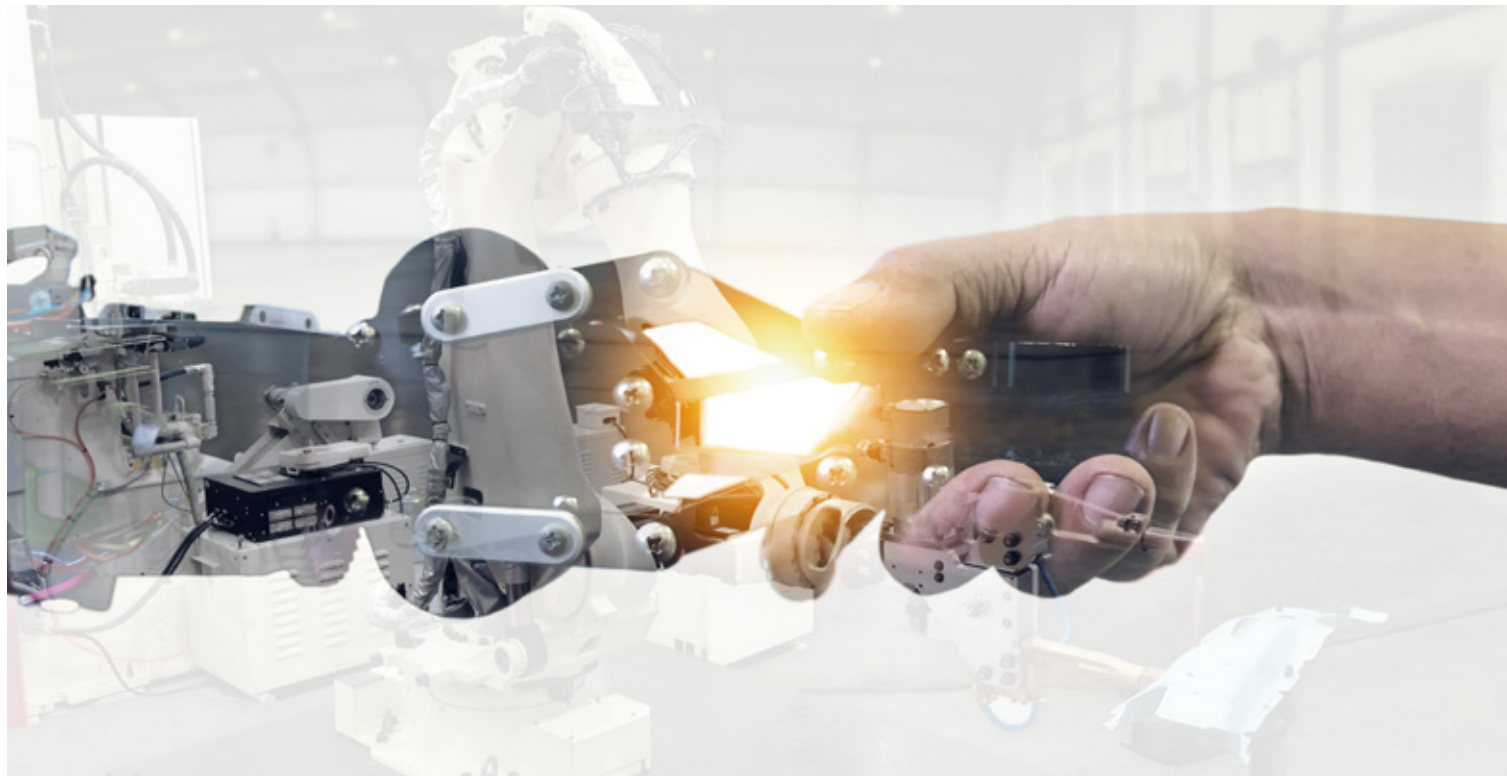
Tavant's Underwriting Assistant is another example of applying machine learning in the mortgage space. Leveraging deep learning models allows users to interpret the results of the ML model hence making it possible to identify which features within the model had high importance in the categorization of a loan as risky or not risky. Continuous feedback-based learning allows the ML model to rank features by importance, and, over a period of time, the models start predicting outcomes well before the loan reaches underwriting, thus improving the overall efficiency in the origination process. Another key area of underwriting assistance is anomaly detection and fraud prediction. Tavant leverages the anonymized and aggregated meta-data created within its Tavant VELOX product suite to train machines on anomalies. These models help detect large deposits or gifts, financial fraud, undisclosed debt, and borrower heuristics to determine potential fraud. Not only for lenders, Tavant is also helping other ancillary businesses determine risk-based pricing for borrowers by leveraging these ML models.

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Affordability Advisor

Similar to the Underwriting Assistant, Tavant has applied Deep Learning models within its borrower portal to give advice to borrowers. The borrower starts a mortgage application with a financial institution using Tavant's FinXperience. The mortgage application interface leverages the service that exposes the Tavant's Affordability Model. It continually calls the service to feed the model with the mortgage application data that the borrower has entered or authorized to use from external data sources (for example, credit bureaus, income/employment/asset verification services, product and pricing engine, etc.).

The model provides the borrower with affordability information as well as credit factors that the credit application is most sensitive to (for example, advise the borrower to lower their LTV by borrowing less, etc.). Borrowers can modify their mortgage application, and the system continually feeds the information into the above model via the service. The borrower continues to get interactive advice on the UI to optimize their application to afford the most optimal mortgage product that the financial institution offers. Once the borrower decides on the most affordable loan product, they can submit the application for approval to the financial institution.

During its usability testing, it was proved that not only borrowers, even loan officers, and mortgage brokers could significantly benefit from this product. Tavant continues to refine the model to incorporate more features into its affordability model in order to provide a richer set of advice to borrowers. Tavant filed a patent for its affordability model in April 2019.

Figure 5: Tavant's Affordability Analysis Tool

Retention Intelligence

Tavant has also turned to AI and ML methods to create a solution that not only predict which borrowers are more likely to pre-pay their loans, they also predict if they are likely to do so in a 6-month window and more likely to accept a refinance offer to help manage customer acquisition cost for lenders.

Tavant's Machine Learning team gathered 15 years' data that was available from public sources to help us analyze loan origination & performance over time, analyze macro-economic data, housing and income data. Tavant's data scientists curated all the data to effectively train Retention Intelligence models. The new, enriched data set was used to train a Deep Learning model that also allows for continual learning for progressive fine-tuning. The model performs at near optimal accuracy in the face of changing market and borrower behavior patterns. We see better results while predicting churn over a6-month period in comparison to predicting churn over a 1-yearperiod.

During usability testing, we spoke to our existing customers to validate our assumptions and outcomes. In one such analysis, we found that the use of our Retention Intelligence model would result in 50% lower retention costs when compared to the use of other traditional retention methods.

How does this model work? Portfolio data can be passed through this model, which scores that data. The scored data is used to populate leads in a CRM system, giving originators information they can use to reach out to those high-likelihood borrowers. Based on the Retention Intelligence model's determination of why a given borrower is likely to finish paying off their loan, lenders can then make personalized offers when aiming for customer retention.

In addition, as the borrower logs onto the loan account management portal, they can be offered refinance products or cross-sold home equity products. Tavant has integrated this Retention Intelligence product with its FinXperience solution to provide lenders and banks with a complete retention and conversion ecosystem. Sub-servicers can leverage the Retention Intelligence product to score their servicing portfolios and help their lender clients with intelligence on the potential churn.
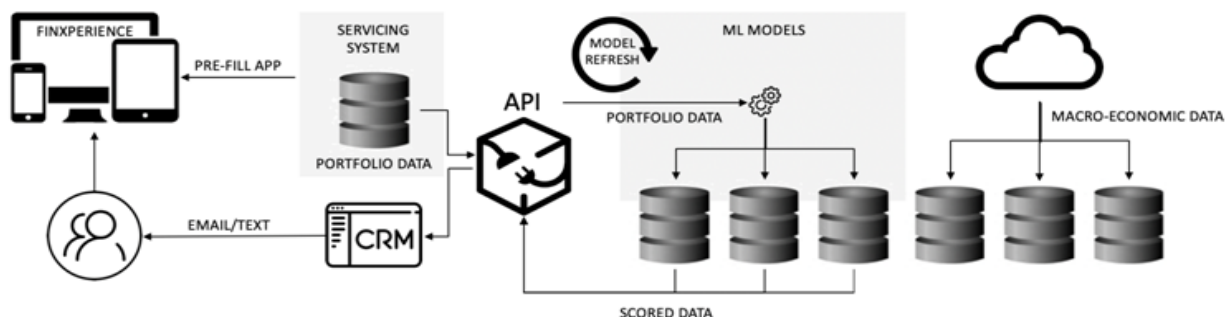

Figure 6: Transfer Learning & Model Deployment

Conclusion

There are multiple reasons why now is a great time to adopt AI/ML in the mortgage space: there is a great deal of data to work with, advances in technology have led to more mature AI tools, and there is increased awareness of the applications of AI in the industry at large.

In addition, AI/ML technology is already being used by some mortgage professionals, and others expect adoption to continue to pick up speed.

In Fannie Mae's "Mortgage Lender Sentiment Survey: How Will Artificial Intelligence Shape Mortgage Lending?", 27% of lenders surveyed said they were already using this technology at some level, and 58% of lenders said that in two years time, they expected to have adopted some AI solutions.[1] The results of that survey were released on October 2018 – that means that the two-years' period is about halfway over, and no one wants to be caught behind the adoption curve.

With so many useful and efficient applications of AI and ML, it's clear that now is the time for wider adoption in the mortgage industry.

Authors' Profiles

Dr. Atul Varshneya,
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Dr. Varshneya is an accomplished technology executive with hands-on knowledge of AI/ML and software technologies and applying them to business problems. Before joining Tavant, he was VP Technology, Artificial Intelligence R&D at Samsung SDS Research America. Varshneya held leadership positions at many other companies, such as AGNITY, BayPackets, and Motorola. He has a Ph.D. from Indian Institute of Technology, Delhi and is passionate about AI, ML and Quantum Computing.

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Head of Fintech Products and Innovation

Abhinav Asthana is the head of products and innovation at Tavant. He is responsible for the overall innovation, go-to-market, and product management strategies for Tavant VΞLOX, the industry's only AI powered digital lending suite of products. In his position, he also builds cutting edge experiences for lenders and mortgage specific companies that reach borrowers, loan officers and brokers and more.

Sources: https://www.fanniemae.com/resources/file/research/mlss/pdf/mlss-artificial-intelligence-100418.pdf

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