ACHARIYA COLLEGE OF ENGINEERING TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Final Review

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Predictive Analytics in E-Commerce CRM: Utilizing ARIMA and Decision Tree Models for Optimal Inventory and Tailored Customer Recommendations

Domain: CLOUD
Subdomain: AI

ABSTRACT

 In this paper, we present a new predictive analytics solution that can be applied to an e-commerce customer relationship management (CRM) system through the combination of two different models. Using an ARIMA (Autoregressive Integrated Moving Average) and LSTM (Long Short-Term Memory) inventory forecasting model, we are able to train a forecasting model that will allow companies to adjust stock levels based on past trends and projected forecasts for the future.

Our next-basket recommendation systems utilize a Decision Tree + Reinforcement Learning model (RNN-Recurrent Neural Network) that allows retailers to get customized product recommendations based on the preferences of individual customers. By using ARIMA+LSTM, we are able to forecast demand patterns more precisely, which allows us to better manage inventory levels. As a result of these models, we are able to gain insights into our operations and the behaviour of our customers.

 Stockouts and overstocking problems aren't as common as they used to be. Alternatively, a combination of Decision Tree + RNN can be used to analyse transaction data in order to detect trends of co-purchased products that can be used to optimize sales and customer satisfaction with targeted marketing campaigns. As compared to conventional methods, our method was significantly more accurate and relevant when compared to conventional methods. Retailers can use this two-model approach to forecast demand, target marketing campaigns, and segment customers based on the two models.

Keywords:

Predictive analytics, Customer Relationship Management (CRM), Deep learning, ARIMA+LSTM, Inventory forecasting, Stock level optimization, Decision Tree + RNN, Next-basket recommendation, Customized product recommendations Demand pattern forecasting, Customer activity insights, Retail applications, Personalized experiences.

ABSTRACT LISTING

- Combines ARIMA+LSTM for accurate inventory forecasting.

- Uses Decision Tree + RNN for personalized product recommendations.

- Reduces stockouts and overstocking.

- Enhances customer insights and marketing strategies.

- Outperforms traditional forecasting and recommendation methods.

INTRODUCTION

- Our project is an **Inventory Management System** with smart prediction and recommendation features.

- It helps manage stock levels and improves customer shopping experience.

- Uses **deep learning models** to forecast inventory and suggest products.

- Built with a **React.js frontend** and a **Node.js microservices backend**.

- Designed for scalability, performance, and real-time insights.

OBJECTIVES

- Develop **LSTM + ARIMA model** for accurate inventory forecasting.

- Build a **Decision Tree + RNN-based recommendation system** for next basket prediction.

- Integrate and visualize the system using a **React.js frontend**.

- Ensure modularity and scalability using a **Node.js microservices backend**.

EXISTING SYSTEM

- Traditional systems rely on **manual tracking** or **basic analytics**.

- Most don't use **advanced forecasting techniques** like LSTM or ARIMA.

- Lack **personalized recommendations** based on user behaviour.

- Often built as **monoliths**, making them hard to scale or maintain.

- Limited integration with **modern tools** like RabbitMQ, Redis, or Google OAuth.

PROBLEM STATEMENT

- Businesses struggle with **inaccurate inventory forecasts**, leading to overstocking or stockouts.

- Lack of **real-time data processing** affects decision-making and customer satisfaction.

- Most systems don't provide **personalized product recommendations**, reducing user engagement.

- Traditional monolithic architectures are **hard to scale**, maintain, and integrate with modern services.

- There's a need for an **intelligent, scalable solution** that combines forecasting and recommendation in one system.

PROPOSED SYSTEM

- An advanced **Inventory Management System** using AI and modern web technologies.

- Implements **LSTM + ARIMA models** for accurate inventory forecasting.

- Uses **Decision Tree + RNN models** for personalized next basket recommendations.

- Built on a **microservices architecture** for better scalability and modularity.

- Frontend developed in **React.js** for dynamic and responsive user experience.

- Integrates **Redis, RabbitMQ, MongoDB**, and **Google OAuth** for enhanced performance and security.

ADVANTAGES OF PROPOSED SYSTEM

- Accurate forecasting reduces overstocking and stockouts using LSTM + ARIMA models

- Personalized recommendations enhance user engagement with Decision Tree + RNN models

- Scalable microservices architecture enables independent service deployment

- Improved performance through Redis caching and RabbitMQ message handling

- Enhanced security with Google OAuth and JWT-based authentication

- User-friendly interface developed with React.js for better UX

- Easy maintenance using Domain-Driven Design and Hexagonal Architecture

SYSTEM REQUIREMENTS

Hardware

- **CPU**: Dual-core 2.0 GHz+

- **RAM**: 8 GB (16 GB recommended)

- **Storage**: 10 GB free (SSD preferred)

Software

- **OS**: Linux, or Windows 10+, macOS,

- **Node.js** v18+, **npm**

- **MongoDB**

- **Python** 3.10+ (for AI modules)

- **Others:** Docker, Redis, RabbitMQ, Git

TECHNOLOGY STACK

Frontend:

- **React.js** – Core framework for building dynamic UI.
- **Tailwind CSS** –Utility based CSS library.

Backend:

- **Python (pytorch, Skykit,FastAPI)** – Used for the Sketch-to-code feature, leveraging machine learning and computer vision.
- **Node.js with Express.js** – Handles API requests and server-side logic for the Drag-and-Drop concept.

Database:
- **MongoDB** – Stores project data, user configurations, and version history.
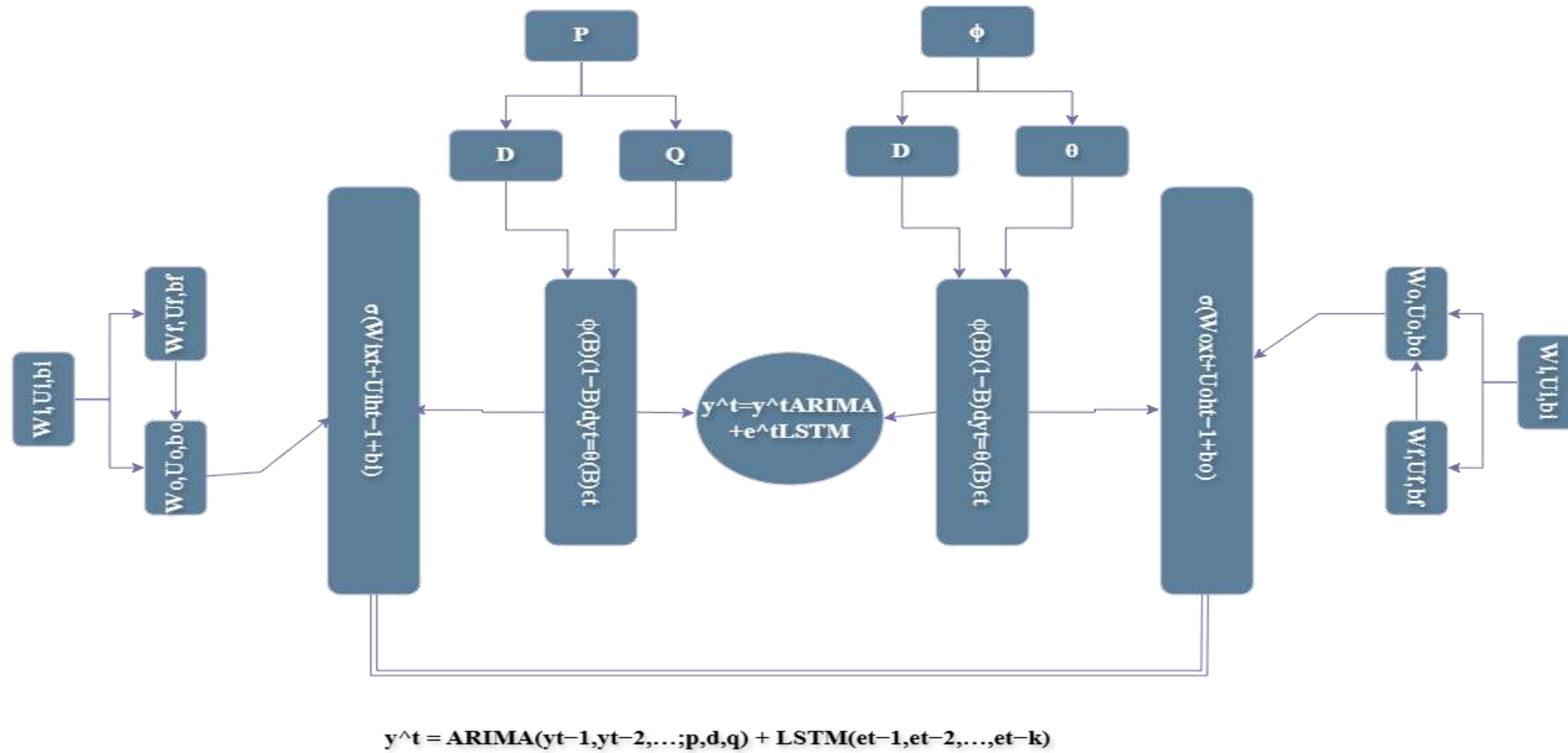- **Redis** – In memory database for caching.

ARCHITECTURE DIAGRAM OF HYBRID MODELS
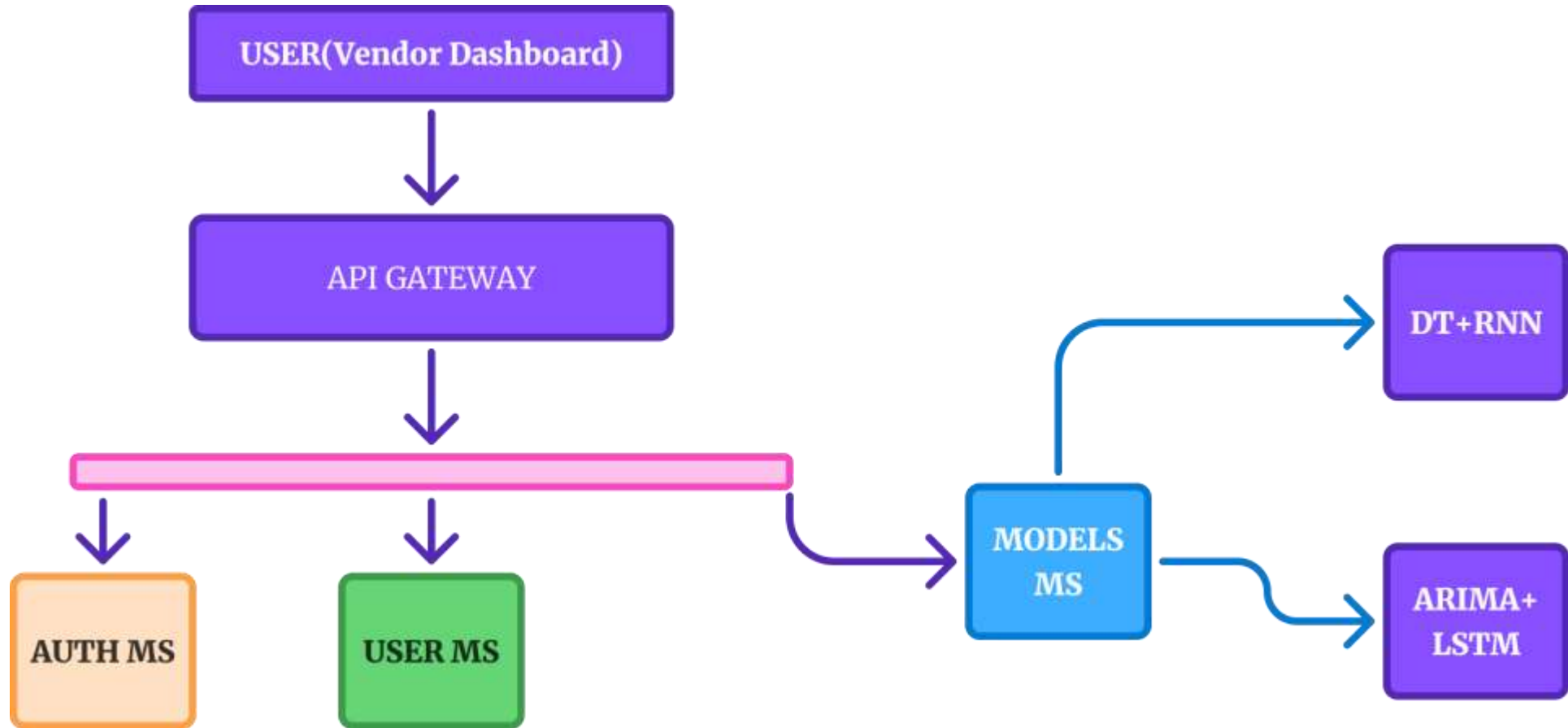
IMPLEMENTATION

- Forecasting Model
- Performance Comparison & Metrics
- Stockout Reduction and Cost Savings
- Next Basket Recommendation Model Accuracy
- Benchmarking with Basket2Vec

FORECASTING MODEL

$$y^t = ARIMA(yt-1, yt-2, \ldots; p,d,q) + LSTM(et-1, et-2, \ldots, et-k)$$

PERFORMANCE COMPARISON & METRICS

Model	MAE	RMSE	WMAPE	Bias	MSIS
ARIMA	28.4	39.2	12.7	+4.3	1.82
LSTM	24.1	33.8	10.9	+1.2	1.64
Prophet	26.7	36.1	11.8	+2.1	1.71
ARIMA+LSTM	18.9	27.3	8.4	−0.4	1.38

STOCKOUT REDUCTION AND COST SAVINGS

NEXT BASKET RECOMMENDATION MODEL ACCURACY

Metric	Our Model	Basket2Vec	Improvement
Top-1 Accuracy	40.2%	8%	402%
Top-5 Accuracy	54.7%	12.84%	326%
Top-10 Accuracy	58.9%	18%	227%
Novelty	0.79	0.41	93%

BENCHMARKING WITH BASKET2VEC

Comparative Performance: Our Model vs Basket2Vec
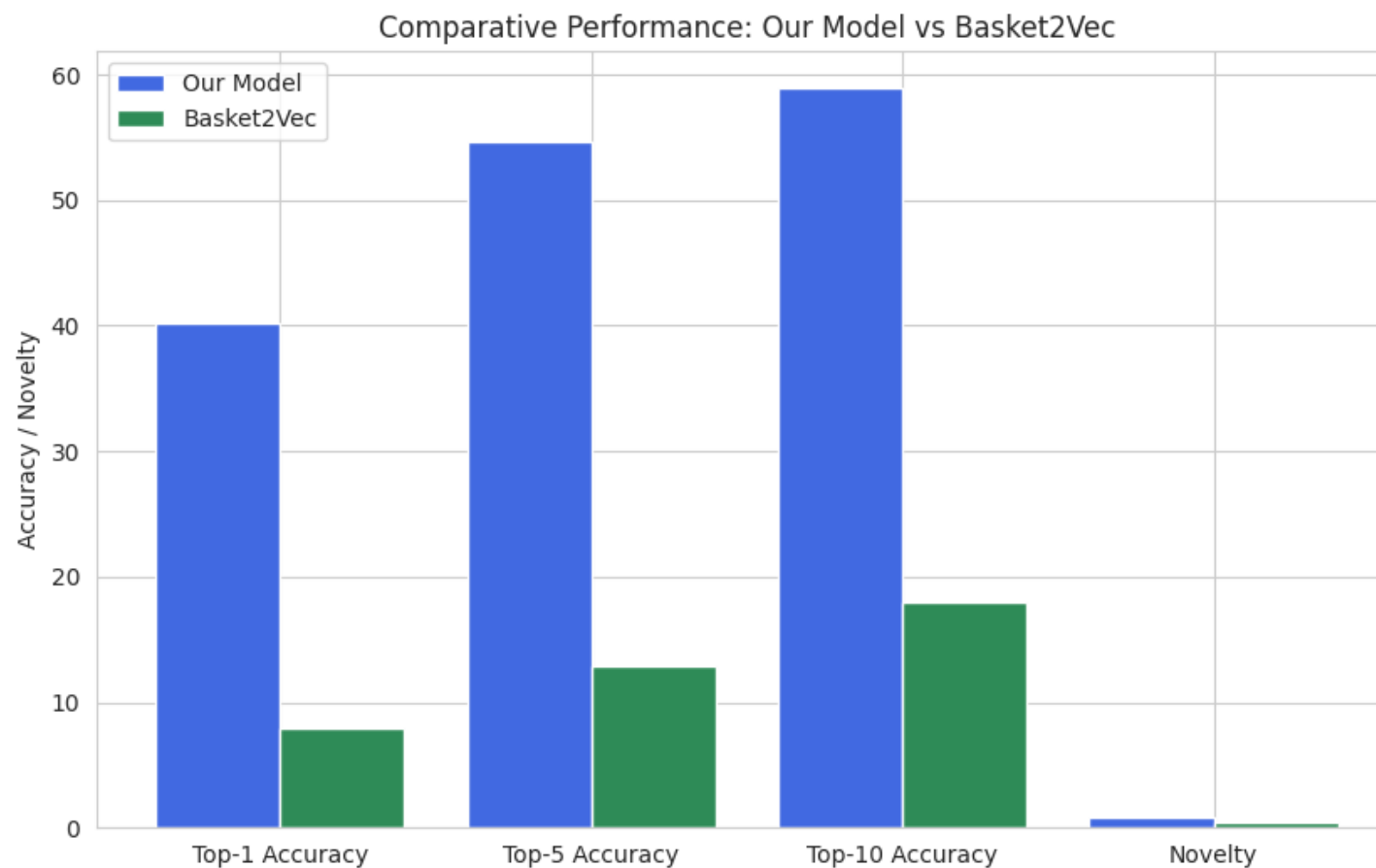
BENCHMARKING WITH BASKET2VEC

Model	MAE	MSE
Basket2Vec	0.32	0.15
DT+RNN	0.175	0.0825

OUTPUT SCREENSHOTS
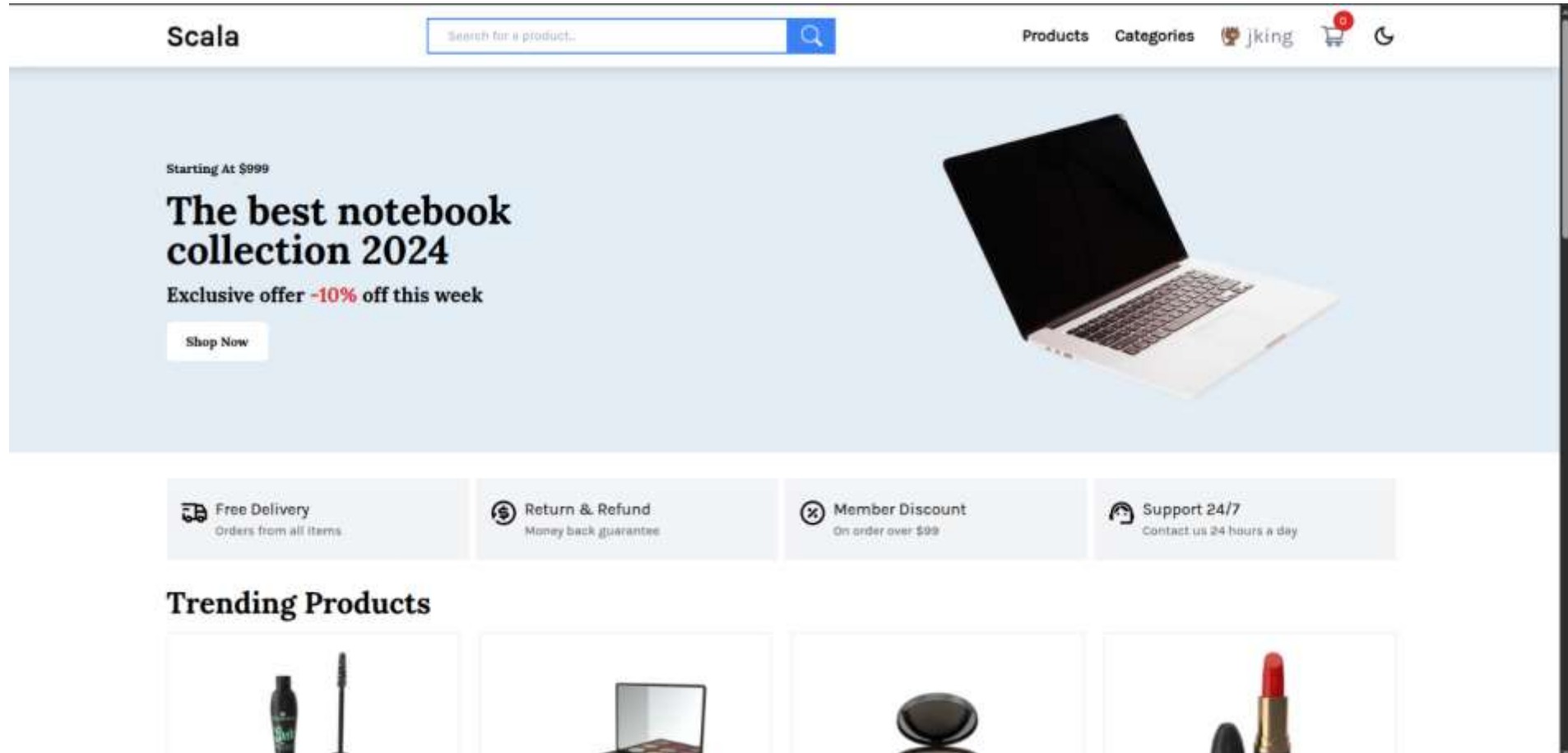
HOME PAGE

$13.51
$14.99 -9.84%

Brand   Velvet Touch
Category   beauty
Stock   89

About the product

The Powder Canister is a finely milled setting powder designed to set makeup and control shine. With a lightweight and translucent formula, it provides a smooth and matte finish. It is important to take care of the patient, to be followed by the patient, but it will happen at such a time that there is a lot of work and pain. For to come to the smallest detail, no one should practice any kind of work unless he derives some benefit from it. Do not be angry with the pain in the reprimand in the pleasure he wants to be a hair from the pain in the hope that there is no breeding. Unless they are blinded by lust, they do not come forth; they are in fault who abandon their duties and soften their hearts, that is, their labors.

rshawe2
★★★☆☆ 3
I found the product not long lasting. The quality also seemed a bit downgraded. I don't think its value for money.

yraigatt3
★★★★☆ 4
The product is nice. I got the delivery on time. I am using it for the last four months. My exprience with this product is very good.

kmeus4
★★★☆☆ 3
The quality could have been better. I feel like wasting my money. I should have been more careful while buying it.

dpettegre6
★★★★★ 5
The product is nice. I got the delivery on time. I am using it for the last four months. My exprience with this product is very good.

I am satisfied with the value for money of the product. Everything seems nice but the delivery time seems a bit delayed

Suggested Products

beauty
Essence Mascara Lash Princess
★★☆☆☆ 2.56
$8.94
$9.99 -10.48%

beauty
Eyeshadow Palette with Mirror
★★☆☆☆ 2.86
$16.35
$19.99 -18.19%

beauty
Red Lipstick
★★★★☆ 4.36
$11.41
$12.99 -12.16%

beauty
Red Nail Polish
★★★★☆ 4.32
$7.96
$8.99 -11.44%

RECOMMENDATION

FUTURE SCOPE

- Expand the recommendation system to include real-time behavioral analysis.

- Integrate with more CRM platforms for wider applicability.

- Region based recommendation.

CONCLUSION

Summary of Work Done:

Developed a hybrid predictive analytics system for E-commerce CRM. Achieved accurate inventory forecasting and personalized recommendations.

Final Thoughts:

The project demonstrates the potential of combining ARIMA and Decision Trees for E-commerce optimization.

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PUBLICATION STATUS

Acknowledgement for paper submission-reg Inbox ×

ijms <ijms@ictacademy.in> 1:57 PM (3 hours ago)
to kannagi.a.acet@achariy.org, me

Dear Author,

Thank you for submitting the paper titled **"PREDICTIVE ANALYTICS IN E-COMMERCE CRM: UTILIZING ARIMA AND DECISION TREE MODELS FOR OPTIMAL INVENTORY AND TAILORED CUSTOMER RECOMMENDATIONS"** for possible publication in ICTACT Journal on **Management Studies**.

The paper has been assigned an ID: **IJMS1370.** Please quote this ID. No. in all the future communications. The paper will undergo plagiarism checking process and then peer blind review process.

Thank you