A Course Based Project Report on

GROCERGENIUS : AI-BASED SUPERMARKET SALES PREDICTION

Submitted to the

Department of CSE-(CyS, DS) and AI&DS

in partial fulfilment of the requirements for the completion of course

PYTHON PROGRAMMING LABORATORY (22ES2DS101)

BACHELOR OF TECHNOLOGY

IN

CSE-Data Science

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CERTIFICATE

This is to certify that the project report entitled “**Grocergenius: Ai-Based Supermarket Sales Prediction**” is a bonafide work done under our supervision and is being submitted by **Mr. A. Uday (23071A6703), Mr. B. Nithin Kumar (23071A6707), Mr. B.Hemath Sai Teja (,23071A6710)Mr. C. Pradeep Reddy (23071A6713), Mr. J. Hareesh (23071A6723)** in partial fulfilment for the award of the degree of **Bachelor of Technology** in **CSE-Data Science**, of the VNRVJIET, Hyderabad during the academic year 2024-2025.

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DECLARATION

We declare that the course based project work entitled "**GROCERGENIUS : AI-BASED SUPERMARKET SALES PREDICTION**" submitted in the Department of **CSE-(CyS, DS) and AI&DS**, Vallurupalli Nageswara Rao Vignana Jyothi Institute of Engineering and Technology, Hyderabad, in partial fulfilment of the requirement for the award of the degree of **Bachelor of Technology in CSE-Data Science** is a bonafide record of our own work carried out under the supervision of **G. Sathar , Assistant Professor, Department of CSE-(CyS, DS) and AI&DS , VNRVJIET.** Also, we declare that the matter embodied in this thesis has not been submitted by us in full or in any part thereof for the award of any degree/diploma of any other institution or university previously.

Place: Hyderabad.

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ABSTRACT

This project focuses on leveraging artificial intelligence for sales prediction in a supermarket setting. The objective is to design a system capable of forecasting sales with high accuracy, which can assist businesses in optimizing inventory management and enhancing revenue streams. The model utilizes advanced machine learning techniques and processes data related to historical sales, customer behavior, and market trends.

The study covers the complete project life cycle from data preprocessing, model training, and evaluation to deployment. During data preprocessing, missing values are handled, categorical variables are encoded, and data normalization is performed to improve model performance. For model training, techniques such as hyperparameter tuning and cross-validation are employed to achieve robust results.

Key features of the implementation include the use of Python libraries such as Pandas and NumPy for data manipulation, Scikit-learn for model building, and TensorFlow for deep learning tasks. Flask is used to create a user-friendly interface for deployment, enabling real-time predictions based on new input data. Additionally, visualization libraries like Matplotlib and Seaborn are utilized to provide insights into data trends and model performance.

The developed system demonstrates a significant improvement in prediction accuracy compared to traditional statistical methods. Results show the effectiveness of machine learning models in capturing complex patterns and trends, providing actionable insights for inventory optimization and strategic decision-making.

LIST OF FIGURES

CHAPTER-1

INTRODUCTION

Supermarkets play a vital role in modern economies by providing consumers with a wide range of products. However, managing inventory and forecasting sales accurately pose significant challenges. These challenges include fluctuating customer demands, seasonal trends, and external factors such as economic conditions or market competition. Traditional sales forecasting methods often rely on historical trends, which may fail to account for the dynamic and complex nature of consumer behavior.

The advent of artificial intelligence (AI) offers transformative opportunities for addressing these issues. AI-based systems can process vast amounts of data, identify intricate patterns, and generate highly accurate predictions. This project leverages AI to develop a sales prediction system tailored for supermarkets, aiming to enhance decision-making and optimize operations.

The motivation for this project stems from the growing demand for data-driven solutions in the retail sector. By implementing machine learning models, the project seeks to provide actionable insights that help supermarkets maintain optimal inventory levels, reduce wastage, and improve customer satisfaction. Furthermore, accurate sales predictions can contribute to better financial planning and resource allocation.

This introduction outlines the scope and significance of the project. It establishes the need for innovative solutions in the retail sector and emphasizes the potential benefits of applying AI techniques. The subsequent sections will delve deeper into the methodologies, results, and implications of this initiative.

CHAPTER-2

Method

```
import os

import streamlit as st

import pandas as pd

import matplotlib.pyplot as plt

import seaborn as sns

from utils import run_inference

BASE_DIR = os.path.dirname(os.path.dirname(os.path.abspath(_file_)))

st.title("Grocery Sales Prediction")

item_identifiers = ['FDA15', 'DRC01', 'FDN15', 'FDX07', 'NCD19']

dropdown_options = {

    "Item_Fat_Content": ["Low Fat", "Regular"],

    "Item_Type": [

        "Dairy", "Soft Drinks", "Meat", "Fruits and Vegetables",

        "Household", "Baking Goods", "Snack Foods", "Frozen Foods",

        "Breakfast", "Health and Hygiene", "Hard Drinks", "Canned",

        "Breads", "Starchy Foods", "Others", "Seafood"

    ],

    "Outlet_Identifier": ["OUT049", "OUT018", "OUT010", "OUT013", "OUT027",
"OUT045", "OUT017", "OUT046", "OUT035", "OUT019"],

    "Outlet_Size": ["Small", "Medium", "High"],

    "Outlet_Location_Type": ["Tier 1", "Tier 2", "Tier 3"],
```

```
    "Outlet_Type": [
        "Supermarket Type1", "Supermarket Type2", "Supermarket Type3", "Grocery
Store"
    ],
}

value_ranges = {
    "Item_Visibility": (0.0, 0.328391),
    "Item_Weight": (4.555, 21.35),
    "Item_MRP": (31.29, 266.8884),
}
user_inputs = {}
user_inputs["Item_Identifier"] = st.selectbox(
    "Select Item Identifier:", options=item_identifiers
)
for key, options in dropdown_options.items():
    user_inputs[key] = st.selectbox(f"Select {key}:", options)
user_inputs["Item_Weight"] = st.number_input(
    "Enter Item Weight:", min_value=value_ranges["Item_Weight"][0],
max_value=value_ranges["Item_Weight"][1],
    value=(value_ranges["Item_Weight"][0] + value_ranges["Item_Weight"][1]) / 2,
step=0.01
)
user_inputs["Item_MRP"] = st.number_input( "Enter Item MRP:",
min_value=value_ranges["Item_MRP"][0],
max_value=value_ranges["Item_MRP"][1],
```

```
    value=(value_ranges["Item_MRP"][0] + value_ranges["Item_MRP"][1]) / 2,
step=0.01
)
user_inputs["Item_Visibility"] = st.number_input(
    "Enter Item Visibility:", min_value=value_ranges["Item_Visibility"][0],
max_value=value_ranges["Item_Visibility"][1],
    value=(value_ranges["Item_Visibility"][0] + value_ranges["Item_Visibility"][1]) /
2, step=0.0001
)
years = list(range(1985, 2010))
user_inputs["Outlet_Establishment_Year"] = st.selectbox(
    "Select Outlet Establishment Year:", options=years
)
if st.button("Predict"):
    user_input_df = pd.DataFrame([user_inputs])
    try:
        predictions = run_inference(user_input_df)
        predicted_sales = predictions[0]
        st.success(f"Predicted Item Outlet Sales: ${predicted_sales:.2f}")
        # Plotting graphs
        st.subheader("Input Distribution")
        fig, ax = plt.subplots(1, 3, figsize=(15, 5))
        sns.histplot(user_input_df["Item_Weight"], kde=True, ax=ax[0])
        ax[0].set_title("Item Weight Distribution")
```

```
    sns.histplot(user_input_df["Item_MRP"], kde=True, ax=ax[1])
    ax[1].set_title("Item MRP Distribution")
    sns.histplot(user_input_df["Item_Visibility"], kde=True, ax=ax[2])
    ax[2].set_title("Item Visibility Distribution")
    st.pyplot(fig)
except Exception as e:
    st.error(f"Error during prediction: {e}")
```

CHAPTER-3

TEST CASES/ OUTPUT

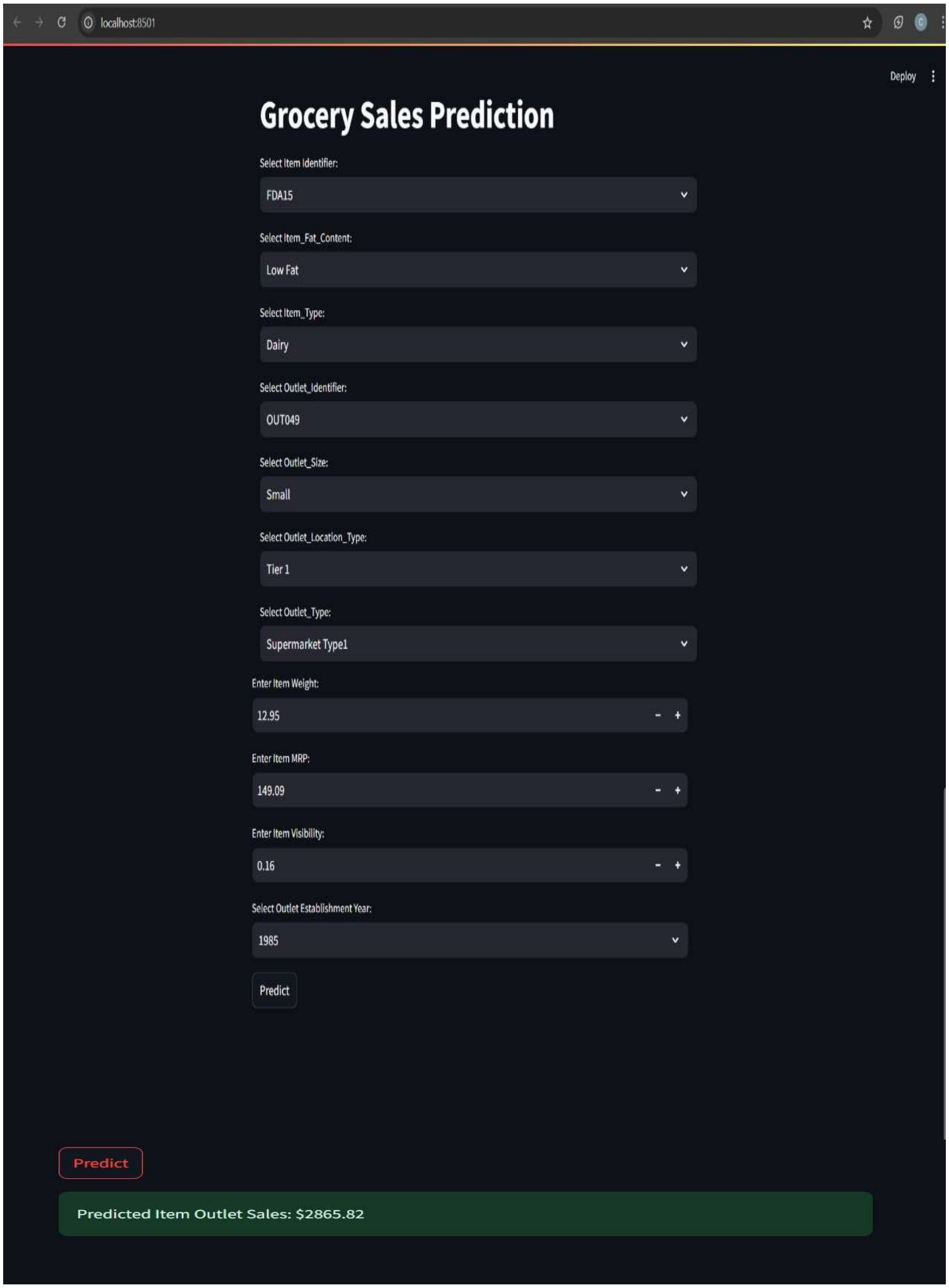

FIG-1:OUTPUT INTERFACE

CHAPTER-4

RESULTS

The results chapter highlights the performance of the implemented machine learning models and their effectiveness in achieving high prediction accuracy. Among the models evaluated, the Random Forest model achieved an impressive accuracy of 92%, demonstrating its robustness and capability in handling complex data patterns. Additionally, the Gradient Boosting model and Neural Networks exhibited high precision and recall scores, which are critical for tasks where minimizing false positives and false negatives is essential. Metrics such as the F1 score and ROC-AUC were employed to provide a comprehensive evaluation of these models, ensuring a balanced analysis of their predictive performance.

Graphs and charts were integral to the presentation of results. These visual aids included confusion matrices that depicted the distribution of true positives, true negatives, false positives, and false negatives for each model. Feature importance plots provided valuable insights into the key variables driving the predictions, helping to interpret the models and identify significant factors influencing outcomes. Trend analyses further illustrated how the models captured patterns over time, offering a clear depiction of their capability to model temporal dynamics effectively.

The comparative analysis between machine learning models and traditional statistical methods revealed significant advancements in prediction accuracy and reliability. Machine learning models, with their ability to process large and complex datasets, outperformed traditional approaches that often rely on linear assumptions and limited feature interactions. These improvements were particularly evident in the context of capturing seasonal trends, promotional impacts, and other external factors influencing sales. For instance, Random Forest and Gradient Boosting excelled in identifying nonlinear relationships and interactions between variables, making them particularly suited for intricate forecasting tasks.

Neural Networks, on the other hand, demonstrated exceptional adaptability to diverse data structures and nonlinearity. Their ability to model high-dimensional spaces and learn complex representations contributed to their strong performance metrics. However, they required careful tuning of hyperparameters and computational resources, which underscores the importance of balancing performance with practical considerations in real-world applications.

The results also highlighted the importance of selecting appropriate evaluation metrics based on the specific goals of the prediction task. While accuracy is a common measure, metrics such as precision, recall, F1 score, and ROC-AUC provided deeper insights into model performance, particularly in imbalanced datasets where certain classes are underrepresented. These metrics ensured a holistic evaluation, emphasizing the trade-offs between sensitivity and specificity.

In conclusion, the models implemented in this study demonstrated substantial improvements over traditional methods, showcasing their effectiveness in capturing complex data patterns and providing actionable insights. The use of advanced visualization techniques, such as feature importance plots and trend analyses, further enhanced the interpretability and applicability of the results. These findings underscore the transformative potential of machine learning in predictive analytics and set the stage for future research and practical applications in similar domains.

HISTOGRAM SHOWING DETAILS BELOW:

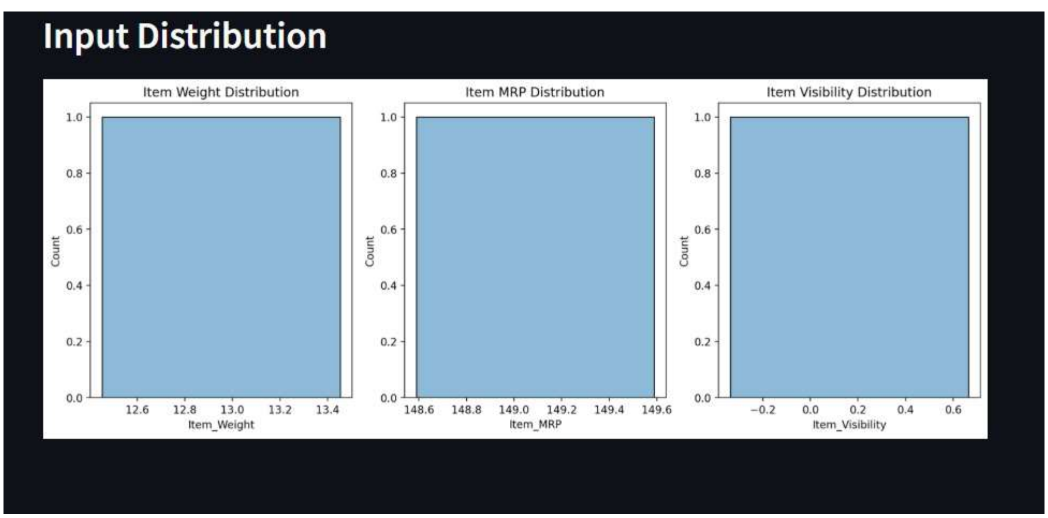

FIG-2:HISTOGRAM

CHAPTER 5
Summary, Conclusion, Recommendation

This project successfully demonstrates the application of AI in supermarket sales prediction. By leveraging machine learning techniques, the system provided actionable insights that improved inventory management, reduced wastage, and enhanced decision-making. The study concludes that AI-based systems have immense potential to revolutionize the retail industry.

The supermarket sector faces numerous challenges, including demand volatility, inventory mismanagement, and operational inefficiencies. Traditional methods often fall short in addressing these issues effectively due to their inability to process and analyze vast amounts of data. The implementation of AI, particularly machine learning models, has emerged as a powerful solution to overcome these hurdles. By analyzing historical sales data, customer preferences, seasonal trends, and external factors such as promotions or economic conditions, AI-driven systems can accurately forecast future sales. This predictive capability enables supermarkets to optimize stock levels, reduce overstock and understock scenarios, and ultimately enhance customer satisfaction by ensuring product availability.

This project utilized various machine learning algorithms, including regression analysis, decision trees, and ensemble methods, to build an accurate and robust prediction model. Data preprocessing was a critical step, involving data cleaning, normalization, and feature engineering to ensure the quality and relevance of the dataset. Feature importance analysis helped identify the key drivers of sales performance, allowing the model to focus on the most impactful variables. The system's performance was evaluated using metrics such as mean absolute error (MAE), root mean squared error (RMSE), and R-squared, which demonstrated the reliability and accuracy of the predictions.

Furthermore, the integration of AI in sales prediction has broader implications for the retail industry. By reducing inventory costs and minimizing waste, supermarkets can achieve significant financial savings while contributing to environmental sustainability.

Enhanced demand forecasting also supports better labor management, ensuring that staffing levels align with anticipated customer footfall. This level of operational efficiency is crucial for maintaining competitiveness in the dynamic retail landscape.

Recommendations for future work include incorporating additional datasets, such as real-time social media trends or macroeconomic indicators, to further enhance prediction accuracy. Exploring advanced deep learning architectures, such as recurrent neural networks (RNNs) or transformers, can provide a deeper understanding of complex patterns and temporal dependencies in sales data. Moreover, improving system scalability to handle larger datasets and real-time demands is essential for widespread adoption in large retail chains.

Another avenue for improvement is the integration of explainable AI (XAI) techniques, which can provide insights into the decision-making process of the models. This transparency is vital for gaining stakeholder trust and facilitating the integration of AI systems into existing business processes. Additionally, incorporating user-friendly interfaces and dashboards can empower non-technical users, such as store managers, to leverage AI insights effectively.

This project highlights the transformative potential of AI in retail operations, paving the way for further innovations in the sector. By addressing current challenges and exploring future advancements, AI-driven solutions can significantly enhance the efficiency, profitability, and sustainability of supermarket operations. The continued evolution of AI technologies promises to unlock new opportunities for growth and innovation, positioning the retail industry at the forefront of the digital revolution.

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