

IBM-NALAIYATHIRAN PROJECT

DemandEst - AI Powered Food Demand Forecaster

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ABSTRACT

A food delivery service has to deal with a lot of perishable raw materials which makes it all, the most important factor for such a company is to accurately forecast daily and weekly demand. Too much inventory in the warehouse means more risk of wastage, and not enough could lead to out-of-stocks – and push customers to seek solutions from your competitors. The replenishment of majority of raw materials is done on weekly basis and since the raw material is perishable, the procurement planning is of utmost importance, the task is to predict the demand for the next 10 weeks. The main aim of this project is to create an appropriate machine learning model to forecast the number of orders to gather raw materials for next ten weeks. To achieve this, we should know the information about of fulfilment center like area, city etc., and meal information like category of food sub category of food price of the food or discount in particular week. By using this data, we can use any classification algorithm to forecast the quantity for 10 weeks. A web application is built which is integrated with the model built.

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1.INTRODUCTION

1.1OVERVIEW

A food delivery service has to deal with a lot of perishable raw materials which makes it all, the most important factor for such a company is to accurately forecast daily and weekly demand. Too much inventory in the warehouse means more risk of wastage, and not enough could lead to out-of-stocks - and push customers to seek solutions from your competitors. The replenishment of the majority of raw materials is done on weekly basis and since the raw material is perishable, the procurement planning is of utmost importance, the task is to predict the demand for the next 10 weeks.

1.2PURPOSE

The main aim of this project is to create an appropriate machine learning model to forecast then number of orders to gather raw materials for next ten weeks. To achieve this, we should know the information about of fulfillment center like area, city etc., and meal information like category of food, sub category of food, price of the food or discount in particular week. By using this data, we can use any classification algorithm to forecast the quantity for 10 weeks. For this a web application is built which is integrated with the model.

2.LITERATURE SURVEY

2.1EXISTING PROBLEM

The replenishment of the majority of raw materials is done on weekly basis and since the raw material is perishable, the procurement planning is of utmost importance. Also the recruiting of staff members at the fulfillment center is an prospect wherein the prediction of orders would be beneficial. Although this is a process that can be done

manually.

2.2REFERENCE

- Adi, G. N. (2018, March 9). Thousands of GO-CAR Drivers on Strike in Surakarta. The Jakarta Post.
<https://www.thejakartapost.com/news/2018/03/08/thousands-of-go-car->

drivers-on-strike-in-surak arta.html

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- Colley, A., & Häkkinen, J. (2018, November). Service Design Methods for Human Computer Interaction. In Proceedings of the 17th International Conference on Mobile and Ubiquitous Multimedia (pp. 563-566).
- Clarke, S. (2006). Transformation Lessons from Coca-Cola Enterprises Inc.: Managing the Introduction of a Structured Forecast Process. Foresight: The International Journal of Applied Forecasting, (4), 21-25.

2.3 PROBLEM STATEMENT DEFINITION

Problem statement to understand your customer's point of view. The Customer Problem Statement template helps you focus on what matters to create experiences people will love.

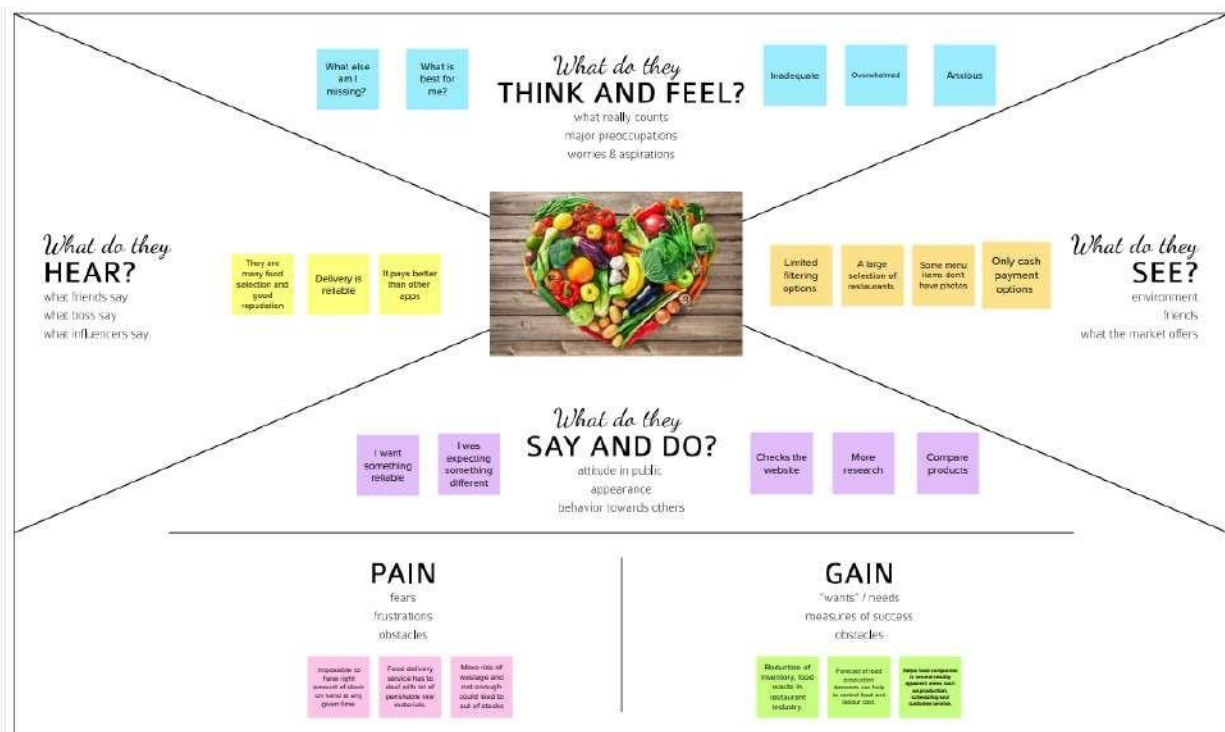
Problem Statement (PS)	I am (Customer)	I'm trying to	But	Because	Which makes me feel
PS-1	Food Delivery Company	(i) buy raw materials. (ii) Plan to predict the demand.	(i) It leads to risk of wastage or out-of-stock. (ii) It takes long time to check the stock.	(i) They don't know the amount of raw materials to be purchased (ii) The prediction is not correct	(i) waste of cost. (ii) Frustrated.
PS-2	Restaurant	(i) Expect sales in a particular period of time. (ii) Predict the amount of sales done in a week.	(i) It is not correct in seasonal days. (ii) not to predict the amount of materials need to buy.	(i) In seasonal days more customers will come. (ii) It leads to out of stock or wastage.	(i) less profitability. (ii) Reduce turnover. (iii) To be complicated.

3.IDEATION & PROPOSED SOLUTION

3.1Empathy Map Canvas

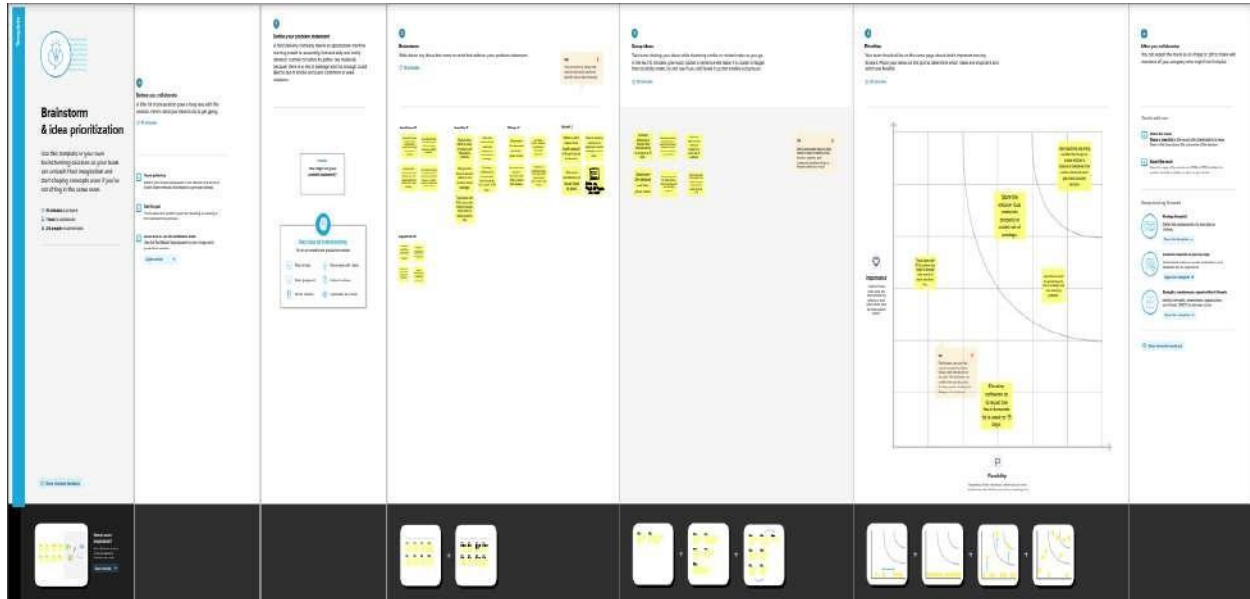
An empathy map is a collaborative visualization used to articulate what we know about a particular type of user. It externalizes knowledge about users in order to 1) create a shared understanding of user needs, and 2) aid in decision making.

Traditional empathy maps are split into 4 quadrants (Says, Thinks, Does, and Feels), with the user or persona in the middle. Empathy maps provide a glance into who a user is as a whole and are not chronological or sequential.



3.2Ideation & Brainstorming

Everyone in a design team should have a *clear* definition of the target problem. They typically gather for a brainstorming session in a room with a large board/wall for pictures/Post-Its. A good mix of participants will expand the experience pool and therefore broaden the idea space.



3.2 Proposed Solution

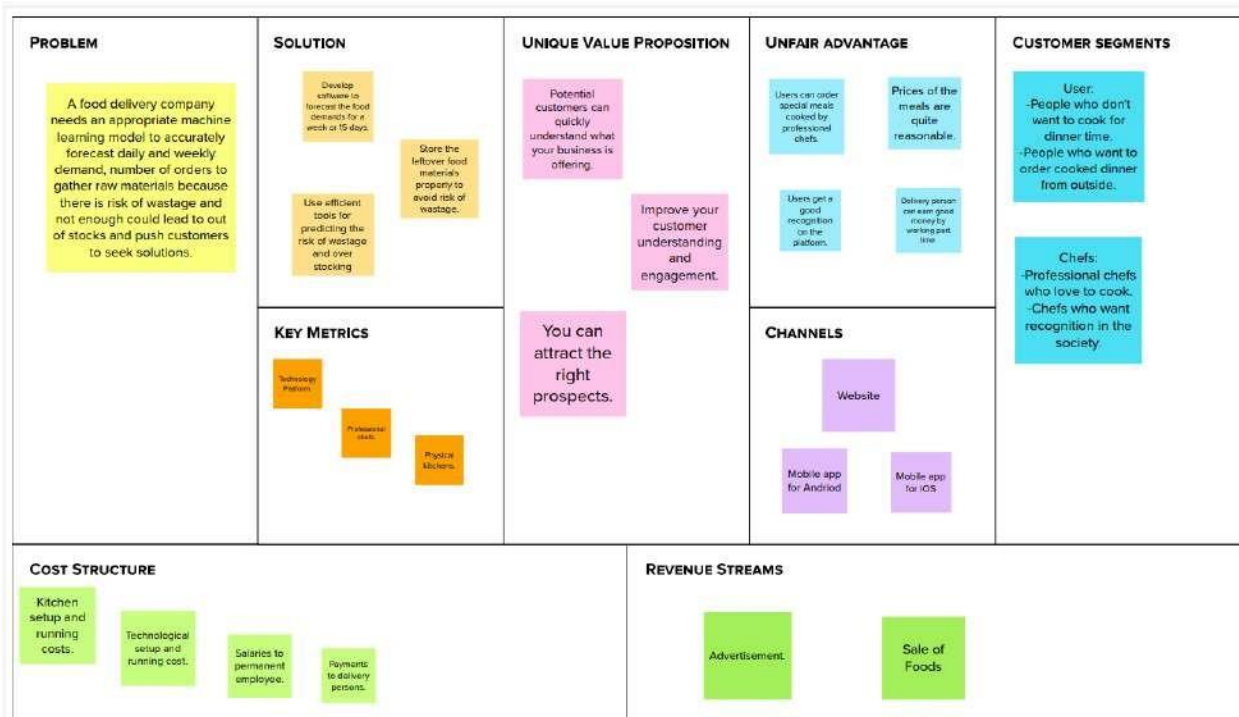
Proposed Solution means the technical solution to be provided by the Implementation agency in response to the requirements and the objectives of the Project. Proposed Solution means the Proposed System with modifications that meet the Agency's requirements as set forth in this RFP. Proposed Solution means the combination of software, hardware, other products or equipment, and any and all services (including any installation, implementation, training, maintenance and support services) necessary to implement the solution described by Vendor in its Proposal.

S.No	TOPIC	CONTENT
1.	Problem Statement	A food delivery company needs an appropriate machine learning model to accurately forecast daily and weekly demand, number of orders to gather raw materials because there is a risk of wastage and not enough could lead to out of stocks and push customers to seek solutions.
2.	Solution	<ul style="list-style-type: none"> ✓Develop software to forecast the food demands for a week or 15 days. ✓Use Machine learning model that help to make efficient balance between the order demand and planned courier service. ✓Store the leftover food materials properly to avoid risk of wastage. ✓Determine the demand and then place order. ✓Use efficient tools for predicting the risk of wastage and over stocking problem. ✓Track sales with POS system that helps to decide how much stock needs to buy.
3.	Business Model	<p>The replenishment of raw materials is done only weekly and since the raw material is perishable, the procurement planning is of utmost importance.</p> <p>Therefore predicting the demand helps in reducing the wastage of raw materials which would result in the reduced cost of operation. Increased customer satisfaction by timely fulfilling their expectations and requirements.</p>
4.	Novelty	AI powered demand forecasting is the strongest method by which to grow revenue and increase profit. The increased accuracy that AI demand forecasts provides results in precise future replenishment quantity predictions. This data reduces missed sales opportunities through stock outs, and also reduces waste, which both directly impact overall profits.

5.	Scalability of Solution	<p>Most demand forecasting solutions focus on small to medium-sized applications that offer low scalability. However, modern food industry businesses are highly diversified in the products that they provide through large chains of network stores.</p> <p>This scale of business presents a significant challenge for traditional demand forecasting software, which is why startups are providing cloud-based solutions geared towards large-scale operations.</p>
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3.4 Problem Solution Fit

The Problem-Solution Fit simply means that you have found a problem with your customer and that the solution you have realized for it actually solves the customer's problem.



4. REQUIREMENT ANALYSIS

4.1 Functional requirement

Functional requirements may involve calculations, technical details, data manipulation and processing, and other specific functionality that define what a system is supposed to accomplish. Behavioral requirements describe all the cases where the system uses the functional requirements, these are captured in use cases.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	The web ordering system	Create an account. Manage their account. Login to the system. Navigate the restaurant's menu. Select an item from the menu. Review their current order.
FR-2	Menu Management system	Add a new/update/delete vendor to/from the menu. Add a new/update/delete food category to/from the menu. Add a new/update/delete food item to/from the menu. Update price for a given food item.
FR-3	Order Retrieval system	Retrieve new orders from the database. Display the orders in an easily readable, graphical way. Mark an order as having been processed and remove it from the list of active orders.

4.2 Non-Functional requirements

In systems engineering and requirements engineering, a non-functional requirement (NFR) is a requirement that specifies criteria that can be used to judge the operation of a system, rather than specific behaviours.

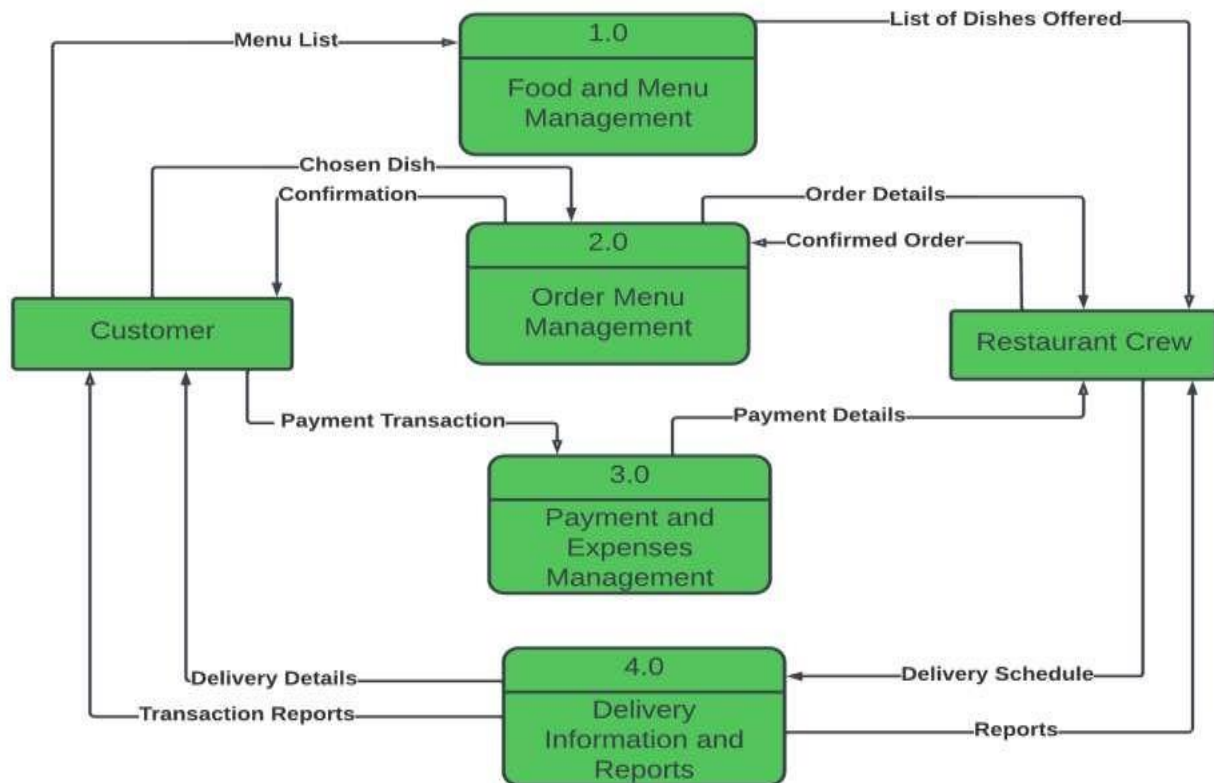
FR No.	Non-Functional Requirement	Description
NFR-1	Usability	The system should provide an interactive user-friendly interface that is easily understandable for all users.
NFR-2	Security	Only authorized users must be able to access the system and view and modify the data.
NFR-3	Maintainability	The software should be easily maintainable and adding new features and making changes to the software must be as simple as possible.
NFR-4	Dependability	The system should provide consistent performance with easy tracking of records and updating of records.

NFR-5	Availability	The system should be available at least during the restaurant operating hours and must be recovered within an hour or less if it fails. The system should respond to the requests within two seconds or less.
NFR-6	Configurability	Configurability is just as important as integrability.

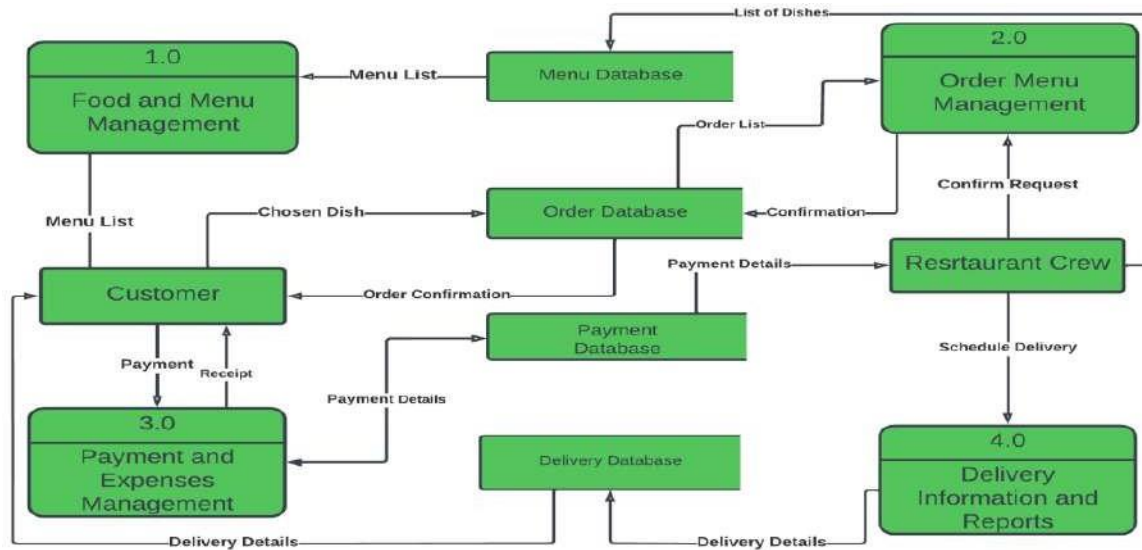
5.PROJECT DESIGN

5.1Data Flow Diagrams

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.



DATA FLOW DIAGRAM –LEVEL 1



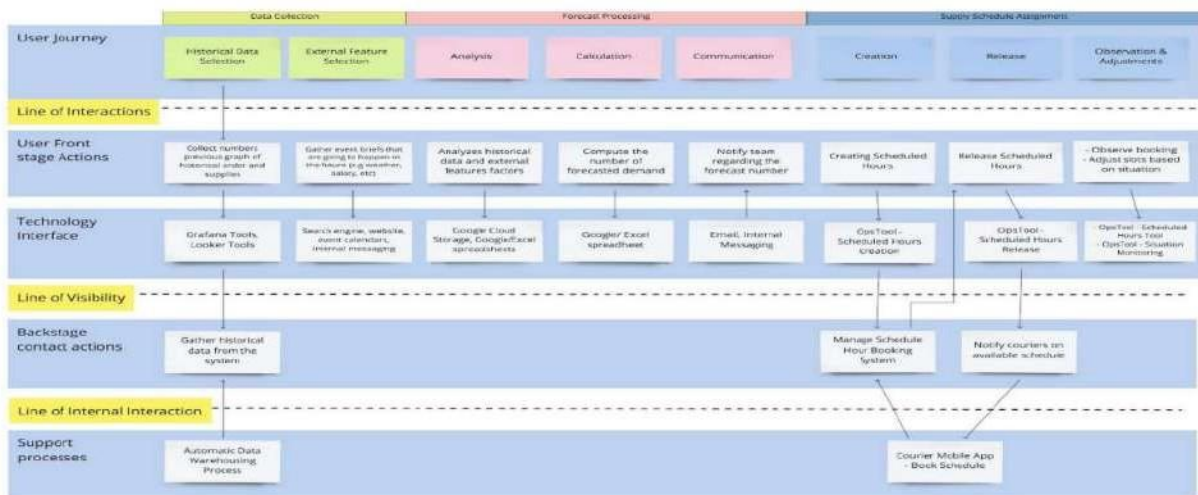
DATA FLOW DIAGRAM –LEVEL 2

5.2 Solution & Technical Architecture

Solution Architecture:

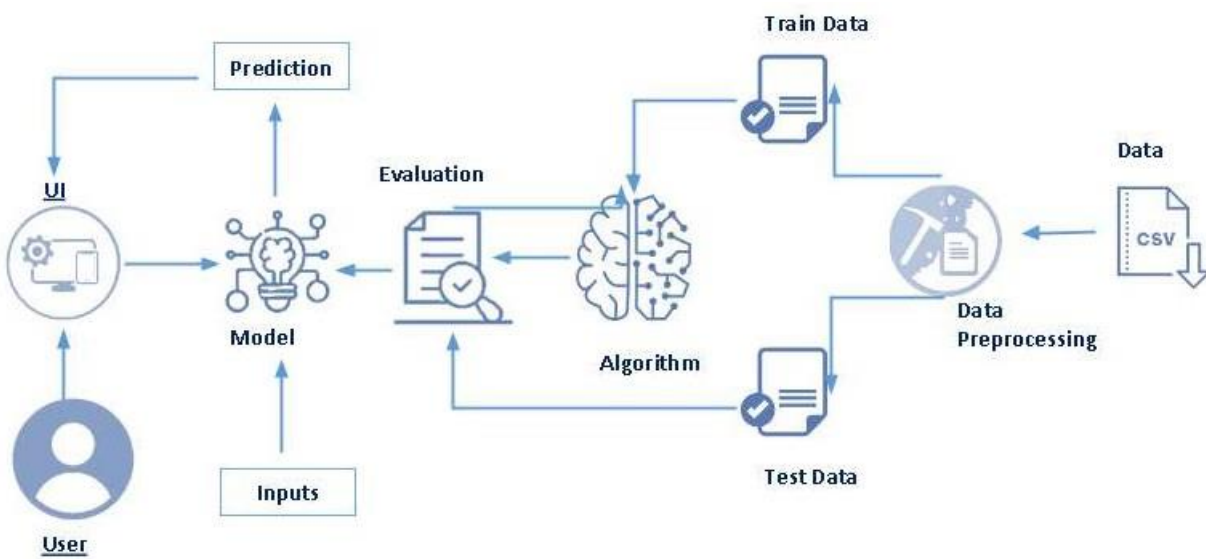
A solution architecture (SA) is an architectural description of a specific solution.

SAs combine guidance from different enterprise architecture viewpoints (business, information and technical), as well as from the enterprise solution architecture (ESA).



Technical Architecture:

Technical Architecture (TA) is a form of IT architecture that is used to design computer systems. It involves the development of a technical blueprint with regard to the arrangement, interaction, and interdependence of all elements so that system- relevant requirements are met.



5.3 User Stories

A user story is an informal, general explanation of a software feature written from the perspective of the end user or customer. The purpose of a user story is to articulate how a piece of work will deliver a particular value back to the customer.

Use the below template to create product backlog and sprint schedule

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	2	High	Rupesh R, Prabhakaran T, Mayilsamy M, GokulKannan R, Santhosh K
Sprint-1		USN-2	As a user, I will receive confirmation email once I have registered for the application	1	High	Rupesh.R Prabhakaran.T Mayilsamy.M Gokul Kannan.R Santhosh.K

Sprint-2		USN-3	As a user, I can register for the application through Facebook	2	Low	Rupesh.R Prabhakaran.T Mayilsamy.M Gokul Kannan.R Santhosh.K
Sprint-2		USN-4	As a user, I can register for the application through Gmail	2	Medium	Rupesh.R Prabhakaran.T Mayilsamy.M Gokul Kannan.R Santhosh.K
Sprint-1	Login	USN-5	As a user, I can log into the application by entering email & password	1	High	Rupesh.R Prabhakaran.T Mayilsamy.M Gokul Kannan.R Santhosh.K
Sprint-1	Dashboard	USN-6	As a user, I can access the services and information provided in the dashboard	2	High	Rupesh.R Prabhakaran.T Mayilsamy.M Gokul Kannan.R Santhosh.K

Sprint-1	Login	USN-7	As a user, I can log into the web application and access the dashboard	1	High	Rupesh.R Prabhakaran.T Mayilsamy.M Gokul Kannan.R Santhosh.K
Sprint-4	Helpdesk	USN-8	As a user, I can get the guidance from the customer care	1	High	Rupesh.R Prabhakaran.T Mayilsamy.M Gokul Kannan.R Santhosh.K

6.PROJECT PLANNING & SCHEDULING

6.1Sprint Planning & Estimation

In Scrum Projects, Estimation is done by the entire team during Sprint Planning Meeting. The objective of the Estimation would be to consider the User Stories for the Sprint by Priority and by the Ability of the team to deliver during the Time Box of the Sprint.

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-3	Management	USN-9	As an administrator, I can collect new datasets and keep the model trained	2	High	Rupesh.R Prabhakaran.T Mayilsamy.M Gokul Kannan.R Santhosh.K
Sprint-3		USN-10	As an administrator, I can update other features of the application	2	Medium	Rupesh.R Prabhakaran.T Mayilsamy.M Gokul Kannan.R Santhosh.K

Sprint-3		USN-11	As an administrator, I can maintain the information about the user	2	Medium	Rupesh.R Prabhakaran.T Mayilsamy.M Gokul Kannan.R Santhosh.K
Sprint-4		USN-12	As an administrator, I can maintain third-party services	1	Low	Rupesh.R Prabhakaran.T Mayilsamy.M Gokul Kannan.R Santhosh.K

6.2 Sprint Delivery Schedule

A sprint schedule is a document that outlines sprint planning from end to end. It's one of the first steps in the agile sprint planning process—and something that requires adequate research, planning, and communication.

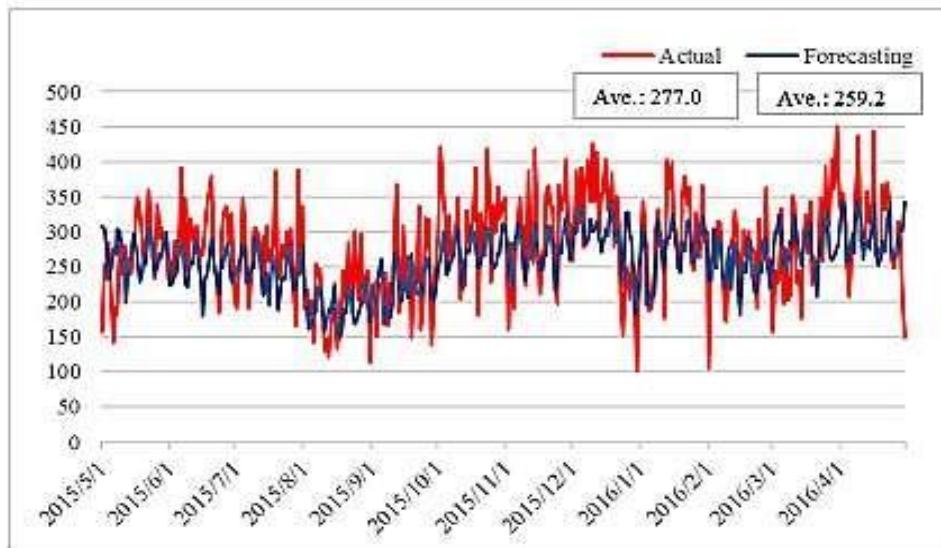
**Project Tracker, Velocity & Burndown
Chart: (4 Marks)**

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on	Sprint Release Date (Actual)
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					Planned End Date)	
Sprint-1	7	6 Days	24 Oct 2022	29 Oct 2022	7	29 Oct 2022
Sprint-2	4	6 Days	31 Oct 2022	05 Nov 2022	4	05 Nov 2022
Sprint-3	6	6 Days	07 Nov 2022	12 Nov 2022	6	12 Nov 2022
Sprint-4	2	6 Days	14 Nov 2022	19 Nov 2022	2	19 Nov 2022

6.3 Reports From JIRA

Jira helps teams plan, assign, track, report, and manage work and brings teams together for everything from agile software development and customer support to start-ups and enterprises. Software teams build better with Jira Software, the #1 tool for agile teams.



7.CODING & SOLUTIONING

7.1Data Dictionary

Our base data consists of four csv files containing information about test data, train data and other required information.

- train.csv: Contains information like id, week, center id, meal id, checkout price, base price, emailer for promotion, homepage featured, number of orders. This file is used for training.

Variable	Definition
id	Unique ID
week	Week No
center_id	Unique ID for fulfillment center
meal_id	Unique ID for Meal
checkout_price	Final price including discount, taxes & delivery charges
base_price	Base price of the meal
emailer_for_promotion	Emailer sent for promotion of meal
homepage_featured	Meal featured at homepage
num_orders	(Target) Orders Count

- test.csv: Contains information like id, week, center id, meal id, checkout price,

base price, emailer for promotion, homepage featured. This file is used for testing.

- `fulfilment_center_info.csv`: Contains information of each fulfillment center.

Variable	Definition
center_id	Unique ID for fulfillment center
city_code	Unique code for city
region_code	Unique code for region
center_type	Anonymized center type
op_area	Area of operation (in km ²)

- `meal_info.csv`: Contains information of each meal being served.

Variable	Definition
meal_id	Unique ID for the meal
category	Type of meal (beverages/snacks/soups....)
cuisine	Meal cuisine (Indian/Italian/...)

7.2 Libraries Used

pandas, numpy, scikit learn, matplotlib, seaborn, xgboost, lightgbm, catboost

7.3 Data Pre-Processing

- There are no Missing/Null Values in any of the three datasets.
- Before proceeding with the prediction process, all the three data

sheets need to be merged into a single dataset. Before performing the merging operation, primary feature for combining the datasets needs to be validated.

- The number of Center IDs in train dataset is matching with the number of CenterIDs in the Centers Dataset i.e 77 unique records. Hence, there won't be any missing values while merging the datasets together.
- The number of Meal IDs in train dataset is matching with the number of Meal IDs in the Meals Dataset i.e 51 unique records. Hence, there won't be any missing values while merging the datasets together.
- As checked earlier, there were no Null/Missing values even after merging the datasets.

7.4 Feature Engineering

Feature engineering is the process of using domain knowledge of the data to create features that improve the performance of the machine learning models.

With the given data, We have derived the below features to improve our model performance.

- Discount Amount : This defines the difference between the “base_Price” and “checkout_price”.
- Discount Percent : This defines the % discount offer to customer.
- Discount Y/N : This defines whether Discount is provided or not - 1 if there is Discount and 0 if there is no Discount.
- Compare Week Price : This defines the increase / decrease in price of a Meal for a particular center compared to the previous week.
- Compare Week Price Y/N : Price increased or decreased - 1 if the Price increased and 0 if the price decreased compared to the previous week.
- Quarter : Based on the given number of weeks, derived a new feature named as Quarter which defines the Quarter of the year.
- Year : Based on the given number of weeks, derived a new feature

named as Year which defines the Year.

7.5 Data Transformation

- Logarithm transformation (or log transform) is one of the most commonly used mathematical transformations in feature engineering. It helps to handle skewed data and after transformation, the distribution becomes more approximate to normal.

- In our data, the target variable 'num_orders' is not normally distributed. Using this without applying any transformation techniques will downgrade the performance of our model.
- Therefore, we have applied Logarithm transformation on our Target feature 'num_orders' post which the data seems to be more approximate to normal distribution.
- After Log transformation, We have observed 0% of Outlier data being present within the Target Variable – num_orders using 3 IQR Method.

7.6 Evaluation Metric

The evaluation metric for this competition is $100 \times \text{RMSLE}$ where RMSLE is Root of Mean Squared Logarithmic Error across all entries in the test set.

7.7 Initial Approach

- Simple Linear Regression model without any feature engineering and data transformation which gave a RMSE : 194.402
- Without feature engineering and data transformation, the model did not perform well and couldn't give a good score.
- Post applying feature engineering and data transformation (log and log1p transformation), Linear Regression model gave a RMSLE score of 0.634.

7.8 Advanced Models

- With improvised feature engineering, built advanced models using Ensemble techniques and other Regressor algorithms.
- Decision Tree Regressors performed well on the model which gave much reduced RMSLE.
- With proper hyper-parameter tuning, Decision Tree Regressor

performed well on the model and gave the test RMSLE of 0.5237

8. TESTING

8.1 Test Cases

A test case includes information such as test steps, expected results and data while a test scenario only includes the functionality to be tested.

Test case ID	Feature Type	Component	Test Scenario
LoginPage_TC_OO1	Functional (Registration)	Home Page	As a user, I can register for the application by entering my email, password, and confirming my password.
LoginPage_TC_OO2	Functional (Conformation)	Home Page	As a User, I will receive confirmation email once I have registered for the application.
LoginPage_TC_OO3	Functional (Accessibility)	Home page	As a user, I can register for the application through Facebook
LoginPage_TC_OO4	Functional (Customer access through mail)	Login page	As a user, I can register for the application through Gmail.
LoginPage_TC_OO4	Functional (Login)	Login page	As a user, I can log out into the application by entering email & password.
LoginPage_TC_OO5	Functional (Dashboard)	Home page	Choosing the menu, Restaurant and payment process. after receiving the food rating process.
LoginPage_TC_OO6	Functional (Customers order)	Home page	Delivery partner simply tracks the order and lets the customer know when it will arrive.
LoginPage_TC_OO7	Functional (Customer order delivery)	Home page	Doorstep delivery. Easy process to get the order.
LoginPage_TC_OO8	Functional (Hotel Management)	Home page	Choosing the restaurant. Multiple choice for restaurant profile.

Pre-Requisite	Steps To Execute
Network Accessing device	<ol style="list-style-type: none"> 1.Check all the text boxes, radio buttons, buttons,etc. 2.Check the required fields by not filling any data. 3.Check user should Register by filling all the required fields.
Network Accessing device	<ol style="list-style-type: none"> 1. Check results on entering valid user ID & Password. 2. Check results on entering invalid User ID & Password. 3. Check response when a user ID is empty & login button is pressed, and many more.
Network Accessing device	<ol style="list-style-type: none"> 1.If the labels are correctly written and placed or not. 2.If the audio/video content is properly audible/visible or not. 3.If the color contrast ratio is maintained or not. 4.If the control actions for video are working fine or
Network Accessing device	<ol style="list-style-type: none"> 1.Enter URL(http://127.0.0.1:5000/) and click go 2.Click on My Account dropdown button 3.Enter InValid username/email in Email text box 4.Enter valid password in password text box 5.Click on login button
Network Accessing device	<ol style="list-style-type: none"> 1.Log in with valid credentials. 2.Check the show password feature. 3.Check the Remember Me checkbox. 4.Check the email. 5.Click on login button
Network Accessing device	<ol style="list-style-type: none"> 1.Test Case ID. 2.Test Description. 3.Assumptions and Pre-Conditions. 4.Test Data.
Network Accessing device	<ol style="list-style-type: none"> 1. Keep things simple and transparent. 2. Make test cases reusable. 3. Peer review is important. 4. Keep test cases IDs unique.
Network Accessing device	<ol style="list-style-type: none"> 1. Making sure that functionalities are easy to find 2. Navigation should be easy and user-friendly 3. Buttons of the application should be visible. 4. Verification that font should be of appropriate size so that anyone can read them.
Network Accessing device	<ol style="list-style-type: none"> 1. Making sure that functionalities are easy to find 2. Navigation should be easy and user-friendly 3. Buttons of the application should be visible. 4. Verification that font should be of appropriate size so that anyone can read them.

Test Data	Expected Result	Actual Result	Status
http://127.0.0.1:5000	Login/Signup popup should display	Working as expected	Pass
http://127.0.0.1:5000	Application should show below UI elements: a.email text box b.password text box c.Login button with orange colour d.New customer? Create account link	Working as expected	Pass
Username: jdk@gmail.com password: FDF123	User should navigate to user account homepage	Working as expected	Pass
Username: jdk@gmail password: FDF123	Application should show 'Incorrect email or password ' validation message.	Working as expected	Pass
Username: jdk@gmail.com password: FDF123678686786876876	Application should show 'Incorrect email or password ' validation message.	Working as expected	Pass
Username: jdk password: FDF123678686786876876	Application should show 'Incorrect email or password ' validation message.	Working as expected	Pass
Username: jdk@gmail password: FDF123	Everything that a customer expects from a product, service or organisation.	Working as expected	Pass
Username: jdk@gmail password: FDF123	It should be made clear how many days a delivery might take to process.	Working as expected	Pass
Username: jdk@gmail password: FDF123	It will be commercially accountable for budgeting and financial management and will need to plan, organise and direct all hotel services.	Working as expected	Pass

8.2 User Acceptance Testing

User Acceptance Testing (UAT), which is performed on most UIT projects, sometimes called beta testing or end-user testing, is a phase of software development in which the software is tested in the "real world" by the intended audience or business representative.

Defect Analysis:

Resolution	Severity1	Severity2	Severity3	Severity4	Subtotal
By Design	10	4	2	3	20
Duplicate	1	0	3	0	4
External	2	3	0	1	6
Fixed	11	2	4	20	37
Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won't Fix	0	0	0	1	1
Totals	24	9	11	26	71


Test Case Analysis:

Section	Total Cases	Not Tested	Fail	Pass
PrintEngine	7	0	0	7
ClientApplication	51	0	0	51
Security	2	0	0	2
OutsourceShipping	3	0	0	3
ExceptionReporting	9	0	0	9
FinalReportOutput	4	0	0	4
VersionControl	2	0	0	2

9.RESULTS

9.1Performance Metrics

Performance testing is the practice of evaluating how a system performs in terms of responsiveness and stability under a particular workload. Performance tests are typically executed to examine speed, robustness, reliability, and application size.

S.No.	Parameter	Values	Screenshot
1.	Metrics	Regression Model: MAE 89.10334778841495, MSE - 43129.82977026746, RMSLE -207.67722496765856, R2 score -0.6946496854280233,	Evaluating the model  <pre>In [33]: from sklearn.metrics import mean_squared_error In [34]: RMSE=np.sqrt(mean_squared_error(y_test,pred)) RMSE Out[34]: 209.71961740201198 In [39]: from sklearn import metrics from sklearn.metrics import mean_absolute_error In [40]: MSE=print(metrics.mean_squared_error(y_test,pred)) MSE 43902.31792324628 In [41]: R2S=print(metrics.r2_score(y_test,pred)) R2S 0.6886142448276894 In [42]: MAE=print(mean_absolute_error(y_test,pred)) MAE 89.10334778841495</pre>

2.	Tune the Model	<p>Hyperparameter Tuning - RMSLE- 52.85812511759974 avg R-squared- 0.123 MSE: -64230.918</p>	<pre> In [36]: print("R squared: {}".format(r2_cv_best_score)) print("best hyperparameters: {}".format(grid_cv_best_params_)) R squared: 0.12311759974 best hyperparameters: {'max_leaf_nodes': None, 'min_samples_leaf': 4, 'min_samples_split': 10} In [37]: # Fit the best model rf_best = rf.GridSearchCV(estimator=rf, param_grid=grid_cv_best_params_, cv=5) rf_best.fit(X_train, y_train) Out[37]: max_depth 0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0 21.0 22.0 23.0 24.0 25.0 26.0 27.0 28.0 29.0 30.0 31.0 32.0 33.0 34.0 35.0 36.0 37.0 38.0 39.0 40.0 41.0 42.0 43.0 44.0 45.0 46.0 47.0 48.0 49.0 50.0 51.0 52.0 53.0 54.0 55.0 56.0 57.0 58.0 59.0 60.0 61.0 62.0 63.0 64.0 65.0 66.0 67.0 68.0 69.0 70.0 71.0 72.0 73.0 74.0 75.0 76.0 77.0 78.0 79.0 80.0 81.0 82.0 83.0 84.0 85.0 86.0 87.0 88.0 89.0 90.0 91.0 92.0 93.0 94.0 95.0 96.0 97.0 98.0 99.0 100.0 101.0 102.0 103.0 104.0 105.0 106.0 107.0 108.0 109.0 110.0 111.0 112.0 113.0 114.0 115.0 116.0 117.0 118.0 119.0 120.0 121.0 122.0 123.0 124.0 125.0 126.0 127.0 128.0 129.0 130.0 131.0 132.0 133.0 134.0 135.0 136.0 137.0 138.0 139.0 140.0 141.0 142.0 143.0 144.0 145.0 146.0 147.0 148.0 149.0 150.0 151.0 152.0 153.0 154.0 155.0 156.0 157.0 158.0 159.0 160.0 161.0 162.0 163.0 164.0 165.0 166.0 167.0 168.0 169.0 170.0 171.0 172.0 173.0 174.0 175.0 176.0 177.0 178.0 179.0 180.0 181.0 182.0 183.0 184.0 185.0 186.0 187.0 188.0 189.0 190.0 191.0 192.0 193.0 194.0 195.0 196.0 197.0 198.0 199.0 200.0 201.0 202.0 203.0 204.0 205.0 206.0 207.0 208.0 209.0 210.0 211.0 212.0 213.0 214.0 215.0 216.0 217.0 218.0 219.0 220.0 221.0 222.0 223.0 224.0 225.0 226.0 227.0 228.0 229.0 230.0 231.0 232.0 233.0 234.0 235.0 236.0 237.0 238.0 239.0 240.0 241.0 242.0 243.0 244.0 245.0 246.0 247.0 248.0 249.0 250.0 251.0 252.0 253.0 254.0 255.0 256.0 257.0 258.0 259.0 260.0 261.0 262.0 263.0 264.0 265.0 266.0 267.0 268.0 269.0 270.0 271.0 272.0 273.0 274.0 275.0 276.0 277.0 278.0 279.0 280.0 281.0 282.0 283.0 284.0 285.0 286.0 287.0 288.0 289.0 290.0 291.0 292.0 293.0 294.0 295.0 296.0 297.0 298.0 299.0 300.0 301.0 302.0 303.0 304.0 305.0 306.0 307.0 308.0 309.0 310.0 311.0 312.0 313.0 314.0 315.0 316.0 317.0 318.0 319.0 320.0 321.0 322.0 323.0 324.0 325.0 326.0 327.0 328.0 329.0 330.0 331.0 332.0 333.0 334.0 335.0 336.0 337.0 338.0 339.0 340.0 341.0 342.0 343.0 344.0 345.0 346.0 347.0 348.0 349.0 350.0 351.0 352.0 353.0 354.0 355.0 356.0 357.0 358.0 359.0 360.0 361.0 362.0 363.0 364.0 365.0 366.0 367.0 368.0 369.0 370.0 371.0 372.0 373.0 374.0 375.0 376.0 377.0 378.0 379.0 380.0 381.0 382.0 383.0 384.0 385.0 386.0 387.0 388.0 389.0 390.0 391.0 392.0 393.0 394.0 395.0 396.0 397.0 398.0 399.0 400.0 401.0 402.0 403.0 404.0 405.0 406.0 407.0 408.0 409.0 410.0 411.0 412.0 413.0 414.0 415.0 416.0 417.0 418.0 419.0 420.0 421.0 422.0 423.0 424.0 425.0 426.0 427.0 428.0 429.0 430.0 431.0 432.0 433.0 434.0 435.0 436.0 437.0 438.0 439.0 440.0 441.0 442.0 443.0 444.0 445.0 446.0 447.0 448.0 449.0 450.0 451.0 452.0 453.0 454.0 455.0 456.0 457.0 458.0 459.0 460.0 461.0 462.0 463.0 464.0 465.0 466.0 467.0 468.0 469.0 470.0 471.0 472.0 473.0 474.0 475.0 476.0 477.0 478.0 479.0 480.0 481.0 482.0 483.0 484.0 485.0 486.0 487.0 488.0 489.0 490.0 491.0 492.0 493.0 494.0 495.0 496.0 497.0 498.0 499.0 500.0 501.0 502.0 503.0 504.0 505.0 506.0 507.0 508.0 509.0 510.0 511.0 512.0 513.0 514.0 515.0 516.0 517.0 518.0 519.0 520.0 521.0 522.0 523.0 524.0 525.0 526.0 527.0 528.0 529.0 530.0 531.0 532.0 533.0 534.0 535.0 536.0 537.0 538.0 539.0 540.0 541.0 542.0 543.0 544.0 545.0 546.0 547.0 548.0 549.0 550.0 551.0 552.0 553.0 554.0 555.0 556.0 557.0 558.0 559.0 560.0 561.0 562.0 563.0 564.0 565.0 566.0 567.0 568.0 569.0 570.0 571.0 572.0 573.0 574.0 575.0 576.0 577.0 578.0 579.0 580.0 581.0 582.0 583.0 584.0 585.0 586.0 587.0 588.0 589.0 590.0 591.0 592.0 593.0 594.0 595.0 596.0 597.0 598.0 599.0 600.0 601.0 602.0 603.0 604.0 605.0 606.0 607.0 608.0 609.0 610.0 611.0 612.0 613.0 614.0 615.0 616.0 617.0 618.0 619.0 620.0 621.0 622.0 623.0 624.0 625.0 626.0 627.0 628.0 629.0 630.0 631.0 632.0 633.0 634.0 635.0 636.0 637.0 638.0 639.0 640.0 641.0 642.0 643.0 644.0 645.0 646.0 647.0 648.0 649.0 650.0 651.0 652.0 653.0 654.0 655.0 656.0 657.0 658.0 659.0 660.0 661.0 662.0 663.0 664.0 665.0 666.0 667.0 668.0 669.0 670.0 671.0 672.0 673.0 674.0 675.0 676.0 677.0 678.0 679.0 680.0 681.0 682.0 683.0 684.0 685.0 686.0 687.0 688.0 689.0 690.0 691.0 692.0 693.0 694.0 695.0 696.0 697.0 698.0 699.0 700.0 701.0 702.0 703.0 704.0 705.0 706.0 707.0 708.0 709.0 710.0 711.0 712.0 713.0 714.0 715.0 716.0 717.0 718.0 719.0 720.0 721.0 722.0 723.0 724.0 725.0 726.0 727.0 728.0 729.0 730.0 731.0 732.0 733.0 734.0 735.0 736.0 737.0 738.0 739.0 740.0 741.0 742.0 743.0 744.0 745.0 746.0 747.0 748.0 749.0 750.0 751.0 752.0 753.0 754.0 755.0 756.0 757.0 758.0 759.0 760.0 761.0 762.0 763.0 764.0 765.0 766.0 767.0 768.0 769.0 770.0 771.0 772.0 773.0 774.0 775.0 776.0 777.0 778.0 779.0 780.0 781.0 782.0 783.0 784.0 785.0 786.0 787.0 788.0 789.0 790.0 791.0 792.0 793.0 794.0 795.0 796.0 797.0 798.0 799.0 800.0 801.0 802.0 803.0 804.0 805.0 806.0 807.0 808.0 809.0 810.0 811.0 812.0 813.0 814.0 815.0 816.0 817.0 818.0 819.0 820.0 821.0 822.0 823.0 824.0 825.0 826.0 827.0 828.0 829.0 830.0 831.0 832.0 833.0 834.0 835.0 836.0 837.0 838.0 839.0 840.0 841.0 842.0 843.0 844.0 845.0 846.0 847.0 848.0 849.0 850.0 851.0 852.0 853.0 854.0 855.0 856.0 857.0 858.0 859.0 860.0 861.0 862.0 863.0 864.0 865.0 866.0 867.0 868.0 869.0 870.0 871.0 872.0 873.0 874.0 875.0 876.0 877.0 878.0 879.0 880.0 881.0 882.0 883.0 884.0 885.0 886.0 887.0 888.0 889.0 890.0 891.0 892.0 893.0 894.0 895.0 896.0 897.0 898.0 899.0 900.0 901.0 902.0 903.0 904.0 905.0 906.0 907.0 908.0 909.0 910.0 911.0 912.0 913.0 914.0 915.0 916.0 917.0 918.0 919.0 920.0 921.0 922.0 923.0 924.0 925.0 926.0 927.0 928.0 929.0 930.0 931.0 932.0 933.0 934.0 935.0 936.0 937.0 938.0 939.0 940.0 941.0 942.0 943.0 944.0 945.0 946.0 947.0 948.0 949.0 950.0 951.0 952.0 953.0 954.0 955.0 956.0 957.0 958.0 959.0 960.0 961.0 962.0 963.0 964.0 965.0 966.0 967.0 968.0 969.0 970.0 971.0 972.0 973.0 974.0 975.0 976.0 977.0 978.0 979.0 980.0 981.0 982.0 983.0 984.0 985.0 986.0 987.0 988.0 989.0 990.0 991.0 992.0 993.0 994.0 995.0 996.0 997.0 998.0 999.0 1000.0 1001.0 1002.0 1003.0 1004.0 1005.0 1006.0 1007.0 1008.0 1009.0 1010.0 1011.0 1012.0 1013.0 1014.0 1015.0 1016.0 1017.0 1018.0 1019.0 1020.0 1021.0 1022.0 1023.0 1024.0 1025.0 1026.0 1027.0 1028.0 1029.0 1030.0 1031.0 1032.0 1033.0 1034.0 1035.0 1036.0 1037.0 1038.0 1039.0 1040.0 1041.0 1042.0 1043.0 1044.0 1045.0 1046.0 1047.0 1048.0 1049.0 1050.0 1051.0 1052.0 1053.0 1054.0 1055.0 1056.0 1057.0 1058.0 1059.0 1060.0 1061.0 1062.0 1063.0 1064.0 1065.0 1066.0 1067.0 1068.0 1069.0 1070.0 1071.0 1072.0 1073.0 1074.0 1075.0 1076.0 1077.0 1078.0 1079.0 1080.0 1081.0 1082.0 1083.0 1084.0 1085.0 1086.0 1087.0 1088.0 1089.0 1090.0 1091.0 1092.0 1093.0 1094.0 1095.0 1096.0 1097.0 1098.0 1099.0 1100.0 1101.0 1102.0 1103.0 1104.0 1105.0 1106.0 1107.0 1108.0 1109.0 1110.0 1111.0 1112.0 1113.0 1114.0 1115.0 1116.0 1117.0 1118.0 1119.0 1120.0 1121.0 1122.0 1123.0 1124.0 1125.0 1126.0 1127.0 1128.0 1129.0 1130.0 1131.0 1132.0 1133.0 1134.0 1135.0 1136.0 1137.0 1138.0 1139.0 1140.0 1141.0 1142.0 1143.0 1144.0 1145.0 1146.0 1147.0 1148.0 1149.0 1150.0 1151.0 1152.0 1153.0 1154.0 1155.0 1156.0 1157.0 1158.0 1159.0 1160.0 1161.0 1162.0 1163.0 1164.0 1165.0 1166.0 1167.0 1168.0 1169.0 1170.0 1171.0 1172.0 1173.0 1174.0 1175.0 1176.0 1177.0 1178.0 1179.0 1180.0 1181.0 1182.0 1183.0 1184.0 1185.0 1186.0 1187.0 1188.0 1189.0 1190.0 1191.0 1192.0 1193.0 1194.0 1195.0 1196.0 1197.0 1198.0 1199.0 1200.0 1201.0 1202.0 1203.0 1204.0 1205.0 1206.0 1207.0 1208.0 1209.0 1210.0 1211.0 1212.0 1213.0 1214.0 1215.0 1216.0 1217.0 1218.0 1219.0 1220.0 1221.0 1222.0 1223.0 1224.0 1225.0 1226.0 1227.0 1228.0 1229.0 1230.0 1231.0 1232.0 1233.0 1234.0 1235.0 1236.0 1237.0 1238.0 1239.0 1240.0 1241.0 1242.0 1243.0 1244.0 1245.0 1246.0 1247.0 1248.0 1249.0 1250.0 1251.0 1252.0 1253.0 1254.0 1255.0 1256.0 1257.0 1258.0 1259.0 1260.0 1261.0 1262.0 1263.0 1264.0 1265.0 1266.0 1267.0 1268.0 1269.0 1270.0 1271.0 1272.0 1273.0 1274.0 1275.0 1276.0 1277.0 1278.0 1279.0 1280.0 1281.0 1282.0 1283.0 1284.0 1285.0 1286.0 1287.0 1288.0 1289.0 1290.0 1291.0 1292.0 1293.0 1294.0 1295.0 1296.0 1297.0 1298.0 1299.0 1300.0 1301.0 1302.0 1303.0 1304.0 1305.0 1306.0 1307.0 1308.0 1309.0 1310.0 1311.0 1312.0 1313.0 1314.0 1315.0 1316.0 1317.0 1318.0 1319.0 1320.0 1321.0 1322.0 1323.0 1324.0 1325.0 1326.0 1327.0 1328.0 1329.0 1330.0 1331.0 1332.0 1333.0 1334.0 1335.0 1336.0 1337.0 1338.0 1339.0 1340.0 1341.0 1342.0 1343.0 1344.0 1345.0 1346.0 1347.0 1348.0 1349.0 1350.0 1351.0 1352.0 1353.0 1354.0 1355.0 1356.0 1357.0 1358.0 1359.0 1360.0 1361.0 1362.0 1363.0 1364.0 1365.0 1366.0 1367.0 1368.0 1369.0 1370.0 1371.0 1372.0 1373.0 1374.0 1375.0 1376.0 1377.0 1378.0 1379.0 1380.0 1381.0 1382.0 1383.0 1384.0 1385.0 1386.0 1387.0 1388.0 1389.0 1390.0 1391.0 1392.0 1393.0 1394.0 1395.0 1396.0 1397.0 1398.0 1399.0 1400.0 1401.0 1402.0 1403.0 1404.0 1405.0 1406.0 1407.0 1408.0 1409.0 1410.0 1411.0 1412.0 1413.0 1414.0 1415.0 1416.0 1417.0 1418.0 1419.0 1420.0 1421.0 1422.0 1423.0 1424.0 1425.0 1426.0 1427.0 1428.0 1429.0 1430.0 1431.0 1432.0 1433.0 1434.0 1435.0 1436.0 1437.0 1438.0 1439.0 1440.0 1441.0 1442.0 1443.0 1444.0 1445.0 1446.0 1447.0 1448.0 1449.0 1450.0 1451.0 1452.0 1453.0 1454.0 1455.0 1456.0 1457.0 1458.0 1459.0 1460.0 1461.0 1462.0 1463.0 1464.0 1465.0 1466.0 1467.0 1468.0 1469.0 1470.0 1471.0 1472.0 1473.0 1474.0 1475.0 1476.0 1477.0 1478.0 1479.0 1480.0 1481.0 1482.0 1483.0 1484.0 1485.0 1486.0 1487.0 1488.0 1489.0 1490.0 1491.0 1492.0 1493.0 1494.0 1495.0 1496.0 1497.0 1498.0 1499.0 1500.0 1501.0 1502.0 1503.0 1504.0 1505.0 1506.0 1507.0 1508.0 1509.0 1510.0 1511.0 1512.0 1513.0 1514.0 1515.0 1516.0 1517.0 1518.0 1519.0 1520.0 1521.0 1522.0 1523.0 1524.0 1525.0 1526.0 1527.0 1528.0 1529.0 1530.0 1531.0 1532.0 1533.0 1534.0 1535.0 1536.0 1537.0 1538.0 1539.0 1540.0 1541.0 1542.0 1543.0 1544.0 1545.0 1546.0 1547.0 1548.0 1549.0 1550.0 1551.0 1552.0 1553.0 1554.0 1555.0 1556.0 1557.0 1558.0 1559.0 1560.0 1561.0 1562.0 1563.0 1564.0 1565.0 1566.0 1567.0 1568.0 1569.0 1570.0 1571.0 1572.0 1573.0 1574.0 1575.0 1576.0 1577.0 1578.0 1579.0 1580.0 1581.0 1582.0 1583.0 1584.0 1585.0 1586.0 1587.0 1588.0 1589.0 1590.0 1591.0 1592.0 1593.0 1594.0 1595.0 1596.0 1597.0 1598.0 1599.0 1600.0 1601.0 1602.0 1603.0 1604.0 1605.0 1606.0 1607.0 1608.0 1609.0 1610.0 1611.0 1612.0 1613.0 1614.0 1615.0 1616.0 1617.0 1618.0 1619.0 1620.0 1621.0 1622.0 1623.0 1624.0 1625.0 1626.0 1627.0 1628.0 1629.0 1630.0 1631.0 1632.0 1633.0 1634.0 1635.0 1636.0 1637.0 1638.0 1639.0 1640.0 1641.0 1642.0</pre>
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10.ADVANTAGES & DISADVANTAGES

Advantages:

1. Food wastage will be minimized.
2. Simple and easy to use framework.

Disadvantages:

1. The output obtained may not be precised, due to the use of limited datasets.

11.APPLICATIONS

This project focuses on one food delivery client, which delivers food in many different cities through distribution networks and fulfillment centers.

12.CONCLUSION

The main moto behind this project is to reduce food wastage. The availability of the food items makes the society better. Our purposed model would definitely come handy to a company for predicting then number of food orders and help them to serve their customers better.

13.FUTURE SCOPE

1. Working on the frontend to make the framework more dynamic.
2. In the future, we also plan to improve forecasting accuracy and research on the efficiency of store management.

14.APPENDIX

SOURCE CODE:

home.html

```
<!DOCTYPE html>
<html>
<head>
<title>Home</title>
<style>
.navbar
{
margin: 0px;
padding:20px;
background-
color:white;
opacity:0.6;
color:black;
font-family:'Roboto',sans-
serif;font-style: italic;
border-
radius:20px;
font-size:25px;
}
a
{
color:grey;
float:right;
text-
decoration:none;
font-
style:normal;
```

```
padding-  
right:20px;  
}  
a:hover{  
background-  
color:black;  
color:white;  
border-  
radius:15px;0  
font-size:30px;  
padding-  
left:10px;
```

```

}
p
{
color:white;
font-
style:italic;
font-
size:30px;
}
body
{
background-image: url("https://img.freepik.com/free-photo/grilled-
chicken-rice-spicy-chickpeas-avocado-cabbage-pepper-buddha-bowl-
dark-top-view_127032-1966.jpg?w=2000");
background-size: cover;
}
</style>
</head>
<body>
<div class="navbar">
<a href="/pred">Predict</a>
<a href="/home">Home</a>
<br>
</div>
<br>
<center><b><font color="yellow" size="15" font-family="Comic Sans
MS" >Food DemandForecasting</font></b></center>
<div>
<br>
<center>
<p>A food delivery service has to deal with a lot of perishable raw
materials which makes it all, the most important factor for such a
company is to accurately forecast daily and weekly demand. Too much

```

inventory in the warehouse means more risk of wastage, and not enough could lead to out-of-stocks - and push customers to seek solutions from your competitors. The replenishment of majority of raw materials is done on weekly basis and since the raw material is perishable, the procurement planning is of utmost importance, the task is to predict the demand for the next 10 weeks.</p>

</center>

</div>


```
</body>
```

```
</html>
```

upload.html

```
<html lang="en">
```

```
  <head>
```

```
    <title>Predict</title>
```

```
    <link
```

```
href="https://cdn.bootcss.com/bootstrap/4.0.0/css/bootstrap.min.css"
```

```
rel="stylesheet">
```

```
  <style>
```

```
    .bar
```

```
    {
```

```
      margin: 0px;
```

```
      padding:20px;
```

```
      background-
```

```
      color:white;
```

```
      opacity:0.6;
```

```
      color:black;
```

```
      font-family:'Roboto',sans-
```

```
      serif;font-style: italic;
```

```
      border-
```

```
      radius:20px;
```

```
      font-size:25px;
```

```
    }
```

```
a
{
color:red;
float:right;
text-
decoration:none;
font-
style:normal;
```

```
padding-right:20px;
}
a:hover{
background-
color:black;
color:white;
border-
radius:15px;0
font-size:30px;
padding-
left:10px;
}
body
{
background-image:
url("https://images.pexels.com/photos/1640777/pexels-photo-
1640777.jpeg?cs=srgb&dl=pexels-ella-olsson-
1640777.jpg&fm=jpg");
background-size: cover;
}
p
{
color:white;
font-
style:italic;
font-
size:30px;
}
```

h1,h2

{

color:0101DF;

}

</style>

</head>

<body>

<div class="bar">

Predict

```
<a href="/home">Home</a>
<br>
</div>
<div class="container">
    <center> <div id="content" style="margin-top:2em">
        <h2><center>Food Demand Forecasting</center></h2>
        <form action="{{ url_for('predict') }}" method="POST">

<select id="homepage_featured" name="homepage_featured">
<option value="">homepage_featured</option>
    <option value="0">No</option>
    <option value="1">Yes</option>

</select><br><br>
<select id="emailer_for_promotion" name="emailer_for_promotion">
<option value="">emailer_for_promotion</option>
    <option value="0">No</option>
    <option value="1">Yes</option>

</select><br><br>

<input class="form-input" type="text" name="op_area"
placeholder="Enter the op_area(2-7)"><br><br>
<select id="cuisine" name="cuisine">
<option value="">Cuisine</option>
    <option value="0">Continental</option>
    <option value="1">Indian</option>
    <option value="2">Italian</option>
```

<option value="3">Thai</option>

</select>


```
<select id="city_code" name="city_code">
    <option value="">City
        Code</option>
        <option
value="590">590</option>
        <option
value="526">526</option>
        <option
value="638">638</option>
<option value="others">Others</option>
```

```
</select><br><br>
```

```
    <select id="region_code" name="region_code">
<option value="">Region Code</option>
    <option value="23">23</option>
    <option value="34">34</option>
    <option value="35">35</option>
    <option value="56">56</option>
    <option value="71">71</option>
    <option value="77">77</option>
    <option value="85">85</option>
    <option value="93">93</option>
</select><br><br>
```

```
<select id="category" name="category">
<option value="">Category</option>
    <option value="0">Beverages</option>
    <option value="1">Biryani</option>
    <option value="2">Desert</option>
    <option value="3">Extras</option>
```

<option value="4">Fish</option>

<option value="5">Other Snacks</option>

<option value="6">Pasta</option>

<option value="7">Pizza</option>

<option value="8">Rice Bowl</option>

<option value="9">Salad</option>


```

        <option value="10">Sandwich</option>
        <option value="11">Seafood</option>
        <option value="12">Soup</option>
        <option value="13">Starters</option>
    </select><br><br>

    <input type="submit" class="my-cta-button" value="Predict">
    </form>
</center>
>
<br>
    <h1 class="predict">Number of orders: { { prediction_text } }</h1>
    </div>
</div>
</body>
</body>

```

app.py

```

# import the necessary
packagesimport pandas as
pd
import numpy
as npimport
pickle import os
from flask import Flask,request,
render_template app=Flask(_name_
,template_folder="templates") @app.route('/',
methods=['GET'])

```

```
def index():  
    return  
    render_template('home.html')  
@app.route('/home',  
methods=['GET']) def about():  
    return  
    render_template('home.html')  
@app.route('/pred',methods=['  
GET'])
```

```

def page():
    return render_template('upload.html')

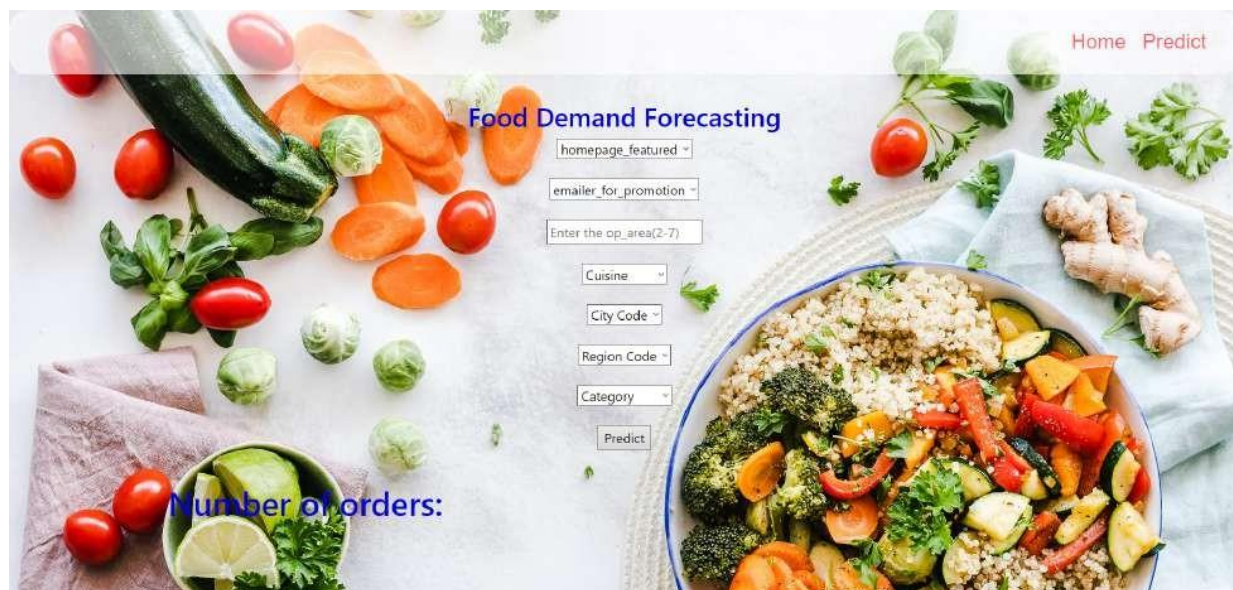
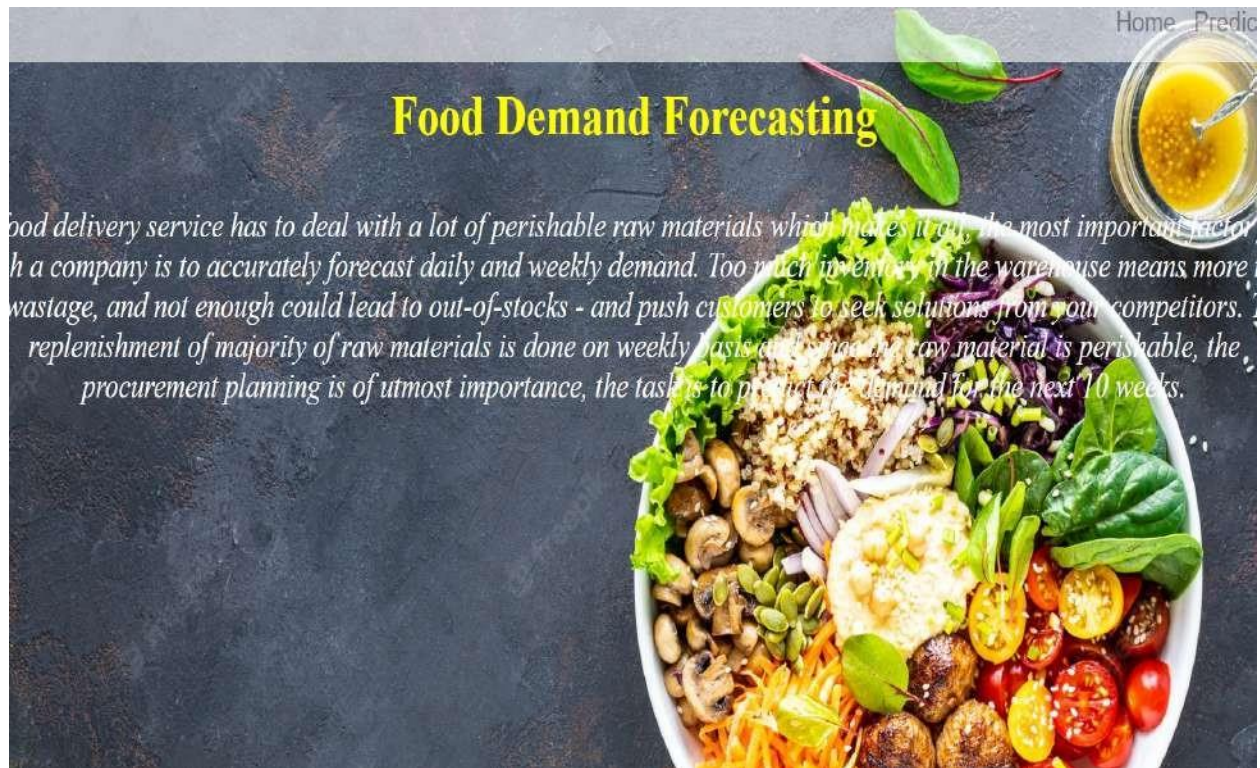
@app.route('/predict', methods=['GET',
'POST'])def predict():
    print("[INFO] loading model...")
    model = pickle.load(open('fdemand.pkl',
'rb')) input_features = [float(x) for x in
request.form.values()] features_value =
[np.array(input_features)]
    print(features_value)

    features_name = ['homepage_featured', 'emailer_for_promotion',
    'op_area', 'cuisine','city_code', 'region_code', 'category']
    prediction =
    model.predict(features_value)
    output=prediction[0]
    print(output)
    return render_template('upload.html', prediction_text=output)

if __name__ == '__main__':
    app.run(debug=False)

```

OUTPUT SCREENSHOTS:





GITHUB LINK:

<https://github.com/IBM-EPBL/IBM-Project-47623-1660800568.git>

PROJECT DEMO LINK:

https://drive.google.com/file/d/1SsDiC6Cpf53P5n379uj3xSZObICOMff1/view?usp=share_link