Gas and Oil Usage Patterns/Predictions

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Introduction

Palmer Gas and Oil is a company that provides heating oil, propane, and related equipment to much of the New England area. They wanted to add a dashboard to their website's customer portal that displays the user's past oil usage history, and can make accurate predictions on future oil usage. This would allow customers to get a better understanding of their oil usage and make adjustments or prepare for future orders. In collaboration with SilverTech Inc., we were able to make that vision a reality!

The model we developed is able to display past and future predicted customer data with features that allow customers to view their data in different ways.

Goals

- Create machine learning model to predict gas purchases for the next 2 months.
- Build a user friendly front end that displays both historical user data as well as predicted data that can be integrated into existing portal.
- Integrate weather data into both front end and machine learning model.
- Select an accurate model to use based on their calculated Root Mean Squared Error.

Machine Learning

- With the help of Azure Machine Learning tools provided to us by SilverTech Inc., we were able to train multiple different types of models through a Python script.
- Our model is trained with historical air temperature data and customer oil purchase data from the past 10 years.
- The data was split 80% into a training set, 10% into a test set, and 10% into a validation set. This was to not only test our model but validate its accuracy.
- Our model will be tested by making predictions on the last year of data collected and then comparing it to the year's actual data.
- The different ML models we ran were Linear Regression, Ridge Regression

Developmental Tools

Python   HTML   CSS   JavaScript   Chart.js   Google Drive   GitLab   Azure ML   Azure
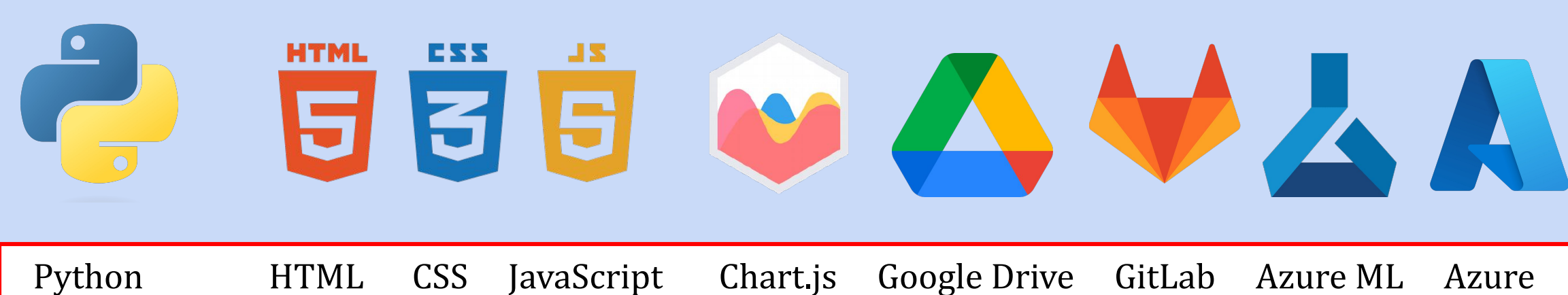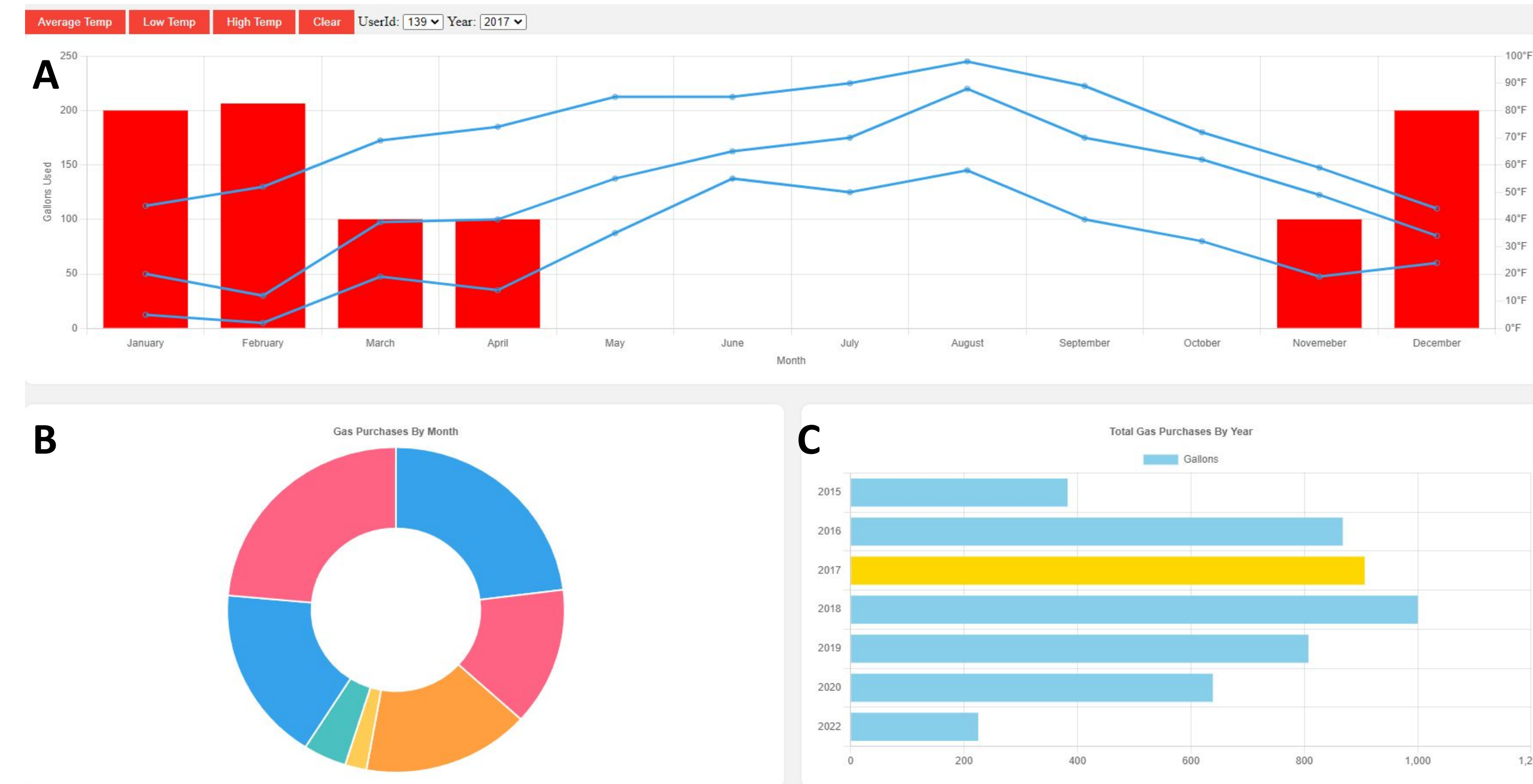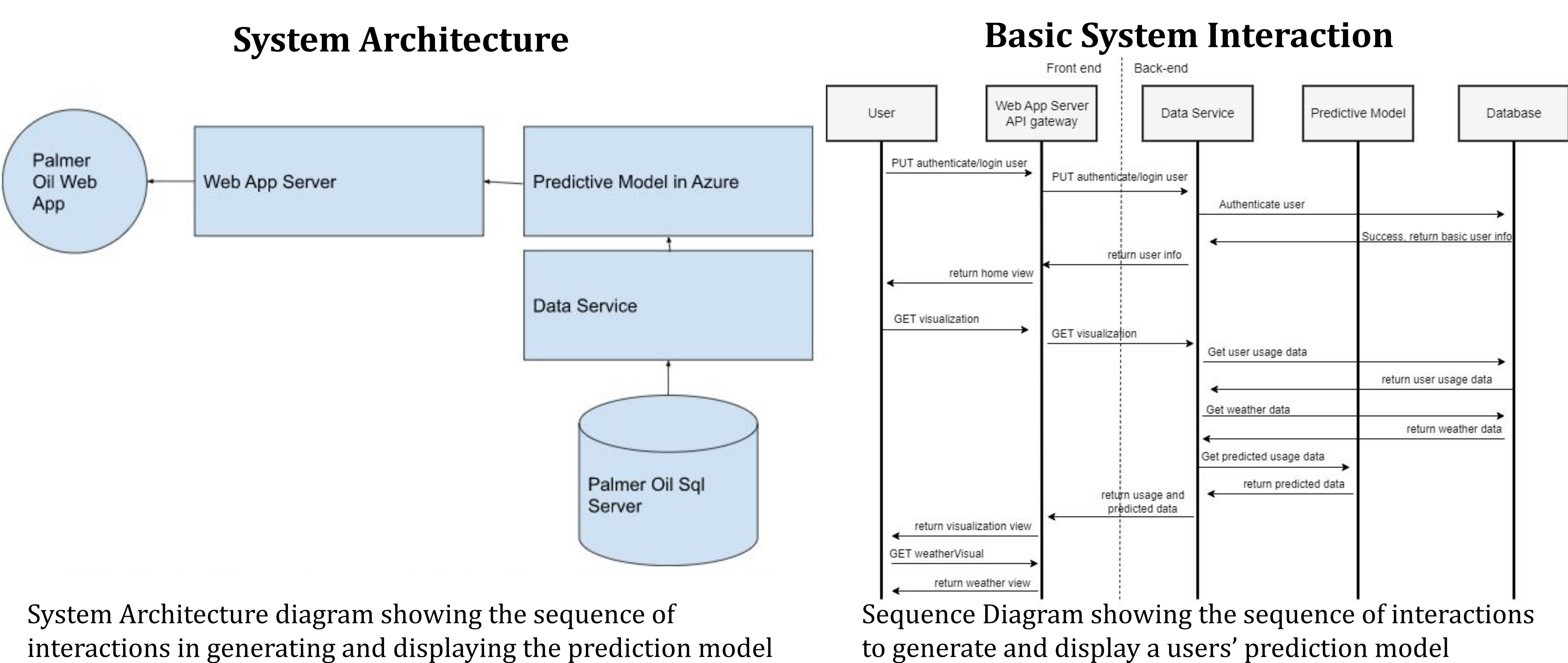
Dashboard

Chart A: This is our chart that shows gas usage by month over a year spawn with options to overlay weather data. predictions will appear in green.

Chart B: This chart shows a customer what percent of oil is purchased in each month over the entire span of their account.

Chart C: This chart shows customers how much oil they purchased each year and highlights selected year in Chart A

System Component

System Architecture

System Architecture diagram showing the sequence of interactions in generating and displaying the prediction model

Basic System Interaction

Sequence Diagram showing the sequence of interactions to generate and display a users' prediction model
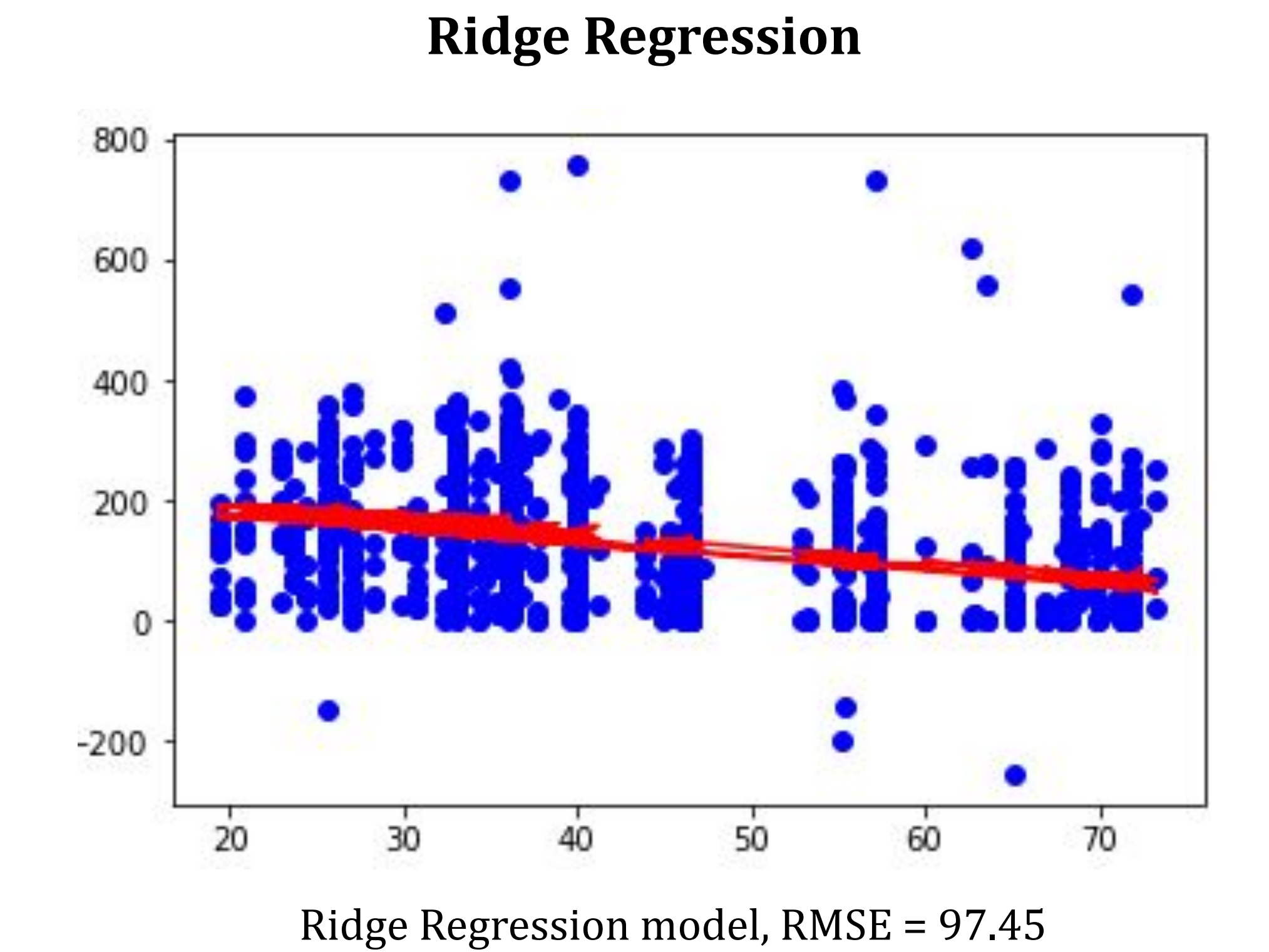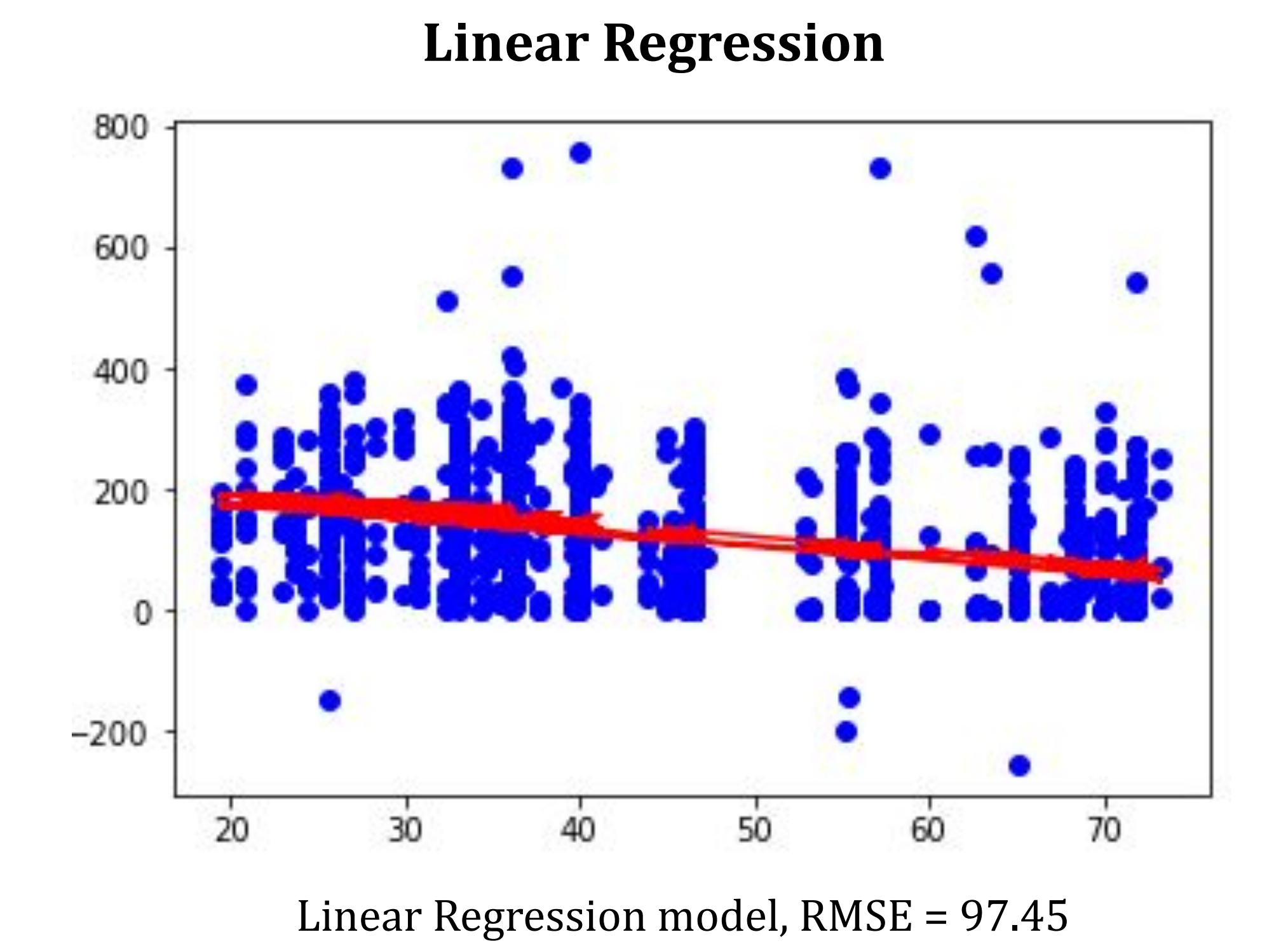
System Architecture

Backend

The backend of this project consists of a machine learning model stored in Palmer Gas and Oil's Azure database. The model was set up with a script and trained using data from the weather API. The script downloads and splits the weather data, sets up the configuration for the model and then begins training multiple models with the organized data. Once the models are trained, the best-performing model was registered and stored in the Azure database to be used by the interactive graph on Palmer Gas and Oil's website

Frontend

The frontend for this project is a web interface that customers can access through the Palmer Oil customer portal. The interface was created using html5, css, javascript and takes advantage of an amazing open source javascript library called Chart.js for the data visualization. The front end consists of a three chart dashboard as explained above. The data for this dashboard is collected through an API call to our backend in Azure that collects purchase history, predicted purchases, and weather data in a JSON file.

Results & Conclusions

The results of the different machine learning models were:

Linear Regression

Linear Regression model, RMSE = 97.45

Ridge Regression

Ridge Regression model, RMSE = 97.45

Acknowledgements

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References

Weather API provided by the NOAA Weather Database

Customer Usage Database provided by Silver Tech Inc.

Charting Library provided by Chart.js