**Ideation Phase**

**Defining the Problem Statements**

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| **Project Name** | **Product Demand Prediction with Machine Learning** |

**Product Demand Prediction with Machine Learning**

**Problem Definition and Design Thinking**

**Introduction**

Product demand prediction is the process of estimating the number of units of a product that will be sold during a specific time period. It is an essential task for businesses of all sizes, as it helps to ensure that the right amount of inventory is available to meet customer demand. Traditional demand prediction methods often rely on historical sales data and expert judgment.

However, these methods can be inaccurate, especially when there are significant changes in market conditions or when new products are being launched. Machine learning (ML) offers a more sophisticated approach to demand prediction. ML algorithms can learn from historical data to identify patterns and trends that can be used to forecast future demand. ML models can also incorporate external factors, such as economic indicators, social media data, and weather data, to improve the accuracy of their predictions.

**Problem Statement**

Businesses face a number of challenges in predicting product demand. These include:

● **Data scarcity**: Businesses may not have enough historical sales data to train an accurate ML model.

● **Data complexity**: Demand data can be complex and noisy, making it difficult to identify meaningful patterns.

● **External factors**: Demand is often influenced by external factors that are difficult to predict, such as economic conditions, weather, and social media trends

**Key Challenges:**

The key challenge of this project is to develop an ML model that can accurately predict product demand, even in the presence of data scarcity and complexity, and taking into account external factors.

* **Data scarcity:** One way to address data scarcity is to use feature engineering to create new features from the existing data. For example, we could create features that represent the product's price, category, and seasonality. We could also incorporate external data sources, such as economic indicators and social media data.
* **Data complexity:** We can address data complexity by using a variety of techniques, such as data cleaning and preprocessing. We can also use ensemble methods, which combine the predictions of multiple ML models to improve accuracy.
* **External factors:** We can address external factors by incorporating external data sources into our ML model. For example, we could include data on economic indicators, weather, and social media trends. We can also use ensemble methods to improve the model's ability to generalize to new data.

**Design Thinking Approach**

**Empathize**

Before diving into solving the problem, it's crucial to empathize with the users and understand their needs. In this case, our primary users are businesses that need to forecast product demand accurately. We need to gather insights into what factors are most important to them when considering demand forecasting and how accurate predictions can benefit them.

**Actions:**

* Conduct surveys or interviews with businesses to gather their perspectives on demand forecasting.
* Analyze historical demand data to identify critical demand drivers.
* Seek feedback from domain experts in the supply chain and operations management industry.

**Define**

Based on our understanding of the problem and the users' needs, we will define clear objectives and success criteria for our project.

**Objectives**:

* Develop a machine learning model that achieves a Mean Absolute Error (MAE) of less than $X on the test data.
* Create a user-friendly web application for businesses to input product details and receive demand predictions.

**Ideate**

Brainstorm potential solutions and approaches to address the problem. This phase involves thinking creatively and considering various algorithms and techniques for product demand prediction.

**Actions:**

* Explore different machine learning algorithms such as linear regression, decision trees, random forests, and neural networks.
* Experiment with feature engineering techniques to enhance model performance.
* Consider incorporating external data sources (e.g., economic indicators, social media data, weather data) to improve predictions.

**Prototype**

Create a prototype of the machine learning model and the user interface for demand prediction.

**Actions:**

* Develop a Jupyter Notebook or Python script for data pre-processing, model training, and evaluation.
* Create a simple web interface using tools like Flask or Django to allow businesses to input product details and receive demand predictions.
* Test the prototype with a subset of the dataset to ensure it meets performance objectives.

**Test**

Evaluate the model's performance using appropriate metrics and gather feedback from users.

**Actions:**

* Split the dataset into training and testing sets.
* Train the model on the training set and evaluate it on the testing set.
* Use metrics such as MAE, Root Mean Square Error (RMSE), and R-squared to assess model performance.
* Collect user feedback on the web interface for usability and accuracy.

**Implement**

Once the prototype meets the defined objectives and receives positive feedback, proceed with full implementation.

**Actions:**

* Train the final machine learning model on the entire dataset.
* Deploy the model as part of a production-ready web application.
* Conduct thorough testing to ensure the application is robust and user-friendly.

**Iterate**

Continuous improvement is essential. Gather user feedback and iterate on the model and interface to enhance accuracy and usability.

**Actions:**

* Monitor the model's performance and retrain it periodically with updated data.
* Address user feedback and make necessary improvements to the web interface.
* Stay informed about advancements in machine learning and product demand forecasting models for potential enhancements.

**Conclusion**

In this document, we've outlined our approach to solving the problem of product demand prediction using machine learning. We've defined the problem, identified key challenges, and laid out a design thinking approach that involves empathizing with users, defining objectives, ideating potential solutions, prototyping, testing, implementing, and iterating.

Our ultimate goal is to develop an accurate and user-friendly solution that provides valuable insights for businesses to optimize inventory management and production planning. By following this structured approach, we aim to create a reliable tool that contributes positively to the supply chain and operations management industry.