11th September 2025

TEAM ROLE AND RESPONSIBILITIES

1. Rahul – Model builder & ML Engineer
Area: Modelling and Training
Responsibility:
- Design and implement ensemble models
- Set up cross-validation and SMAPE loss optimization
- Integrate features from NLP & Vision specialists
- Optimize hyperparameters, ensemble weighting - Document model architecture and code

2. Vamsi – NLP & Vision Specialist
Area: Text feature engineering and Image feature engineering
Responsibility:
- Design, test, and optimize text preprocessing steps (tokenization, stopwords, stemming)
- Extract features using TF-IDF, n-grams, keyword detection
- Implement numerical/categorical extraction from catalog_content
- Document feature extraction pipeline
- Download images using provided scripts (retry logic)
- Extract color, texture, and shape features
- Optimize parallel image processing
- Document image/cv pipeline

3. Subhasis – Data Engineer
Area: Data preprocessing & management
Responsibility:
- Download, clean, and preprocess datasets
- Handle missing values, corrupted images
- Set up scripts for data loading
- Automate image feature extraction pipeline
- Maintain folder/data structure

4. Sachin – Project Manager
Area: Integration, Testing, Reporting
Responsibility:
- Integrate code from all members into the main pipeline
- Oversee experiment tracking and performance logging
- Handle validation/testing/inference on test data
- Prepare submission file as per specification
- Write 1-page methodology report
- Coordinate weekly sync-ups and troubleshooting

5. Utkarsh – Reviewer
Area: Offer suggestions, Moderator
Responsibility:
- Explore the project in depth

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ABOUT PROJECT

# ML Challenge 2025 Problem Statement

## Smart Product Pricing Challenge

In e-commerce, determining the optimal price point for products is crucial for marketplace success and customer satisfaction. Your challenge is to develop an ML solution that analyzes product details and predict the price of the product. The relationship between product attributes and pricing is complex - with factors like brand, specifications, product quantity directly influence pricing. Your task is to build a model that can analyze these product details holistically and suggest an optimal price.

### Data Description:

The dataset consists of the following columns:

1. **sample_id:** A unique identifier for the input sample
2. **catalog_content:** Text field containing title, product description and an Item Pack Quantity(IPQ) concatenated.
3. **image_link:** Public URL where the product image is available for download.
   Example link - https://m.media-amazon.com/images/I/71XfHPR36-L.jpg
   To download images use `download_images` function from `src/utils.py`. See sample code in `src/test.ipynb`.
4. **price:** Price of the product (Target variable - only available in training data)

### Dataset Details:

- **Training Dataset:** 75k products with complete product details and prices
- **Test Set:** 75k products for final evaluation

### Output Format:

The output file should be a CSV with 2 columns:

1. **sample_id:** The unique identifier of the data sample. Note the ID should match the test record sample_id.
2. **price:** A float value representing the predicted price of the product.

Note: Make sure to output a prediction for all sample IDs. If you have less/more number of output samples in the output file as compared to test.csv, your output won't be evaluated.

### File Descriptions:

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Source files

1. **src/utils.py:** Contains helper functions for downloading images from the image_link. You may need to retry a few times to download all images due to possible throttling issues.
2. **sample_code.py:** Sample dummy code that can generate an output file in the given format. Usage of this file is optional.

Dataset files

1. **dataset/train.csv:** Training file with labels (`price`).
2. **dataset/test.csv:** Test file without output labels (`price`). Generate predictions using your model/solution on this file's data and format the output file to match sample_test_out.csv
3. **dataset/sample_test.csv:** Sample test input file.
4. **dataset/sample_test_out.csv:** Sample outputs for sample_test.csv. The output for test.csv must be formatted in the exact same way. Note: The predictions in the file might not be correct

### Constraints:

1. You will be provided with a sample output file. Format your output to match the sample output file exactly.

2. Predicted prices must be positive float values.

3. Final model should be a MIT/Apache 2.0 License model and up to 8 Billion parameters.

### Evaluation Criteria:

Submissions are evaluated using **Symmetric Mean Absolute Percentage Error (SMAPE)**: A statistical measure that expresses the relative difference between predicted and actual values as a percentage, while treating positive and negative errors equally.

Formula:
```
SMAPE = (1/n) * Σ |predicted_price - actual_price| / ((|actual_price| + |predicted_price|)/2)
```

Example: If actual price = $100 and predicted price = $120
SMAPE = |100-120| / ((|100| + |120|)/2) * 100% = 18.18%

Note: SMAPE is bounded between 0% and 200%. Lower values indicate better performance.

### Leaderboard Information:

- **Public Leaderboard:** During the challenge, rankings will be based on 25K samples from the test set to provide real-time feedback on your model's performance.
- **Final Rankings:** The final decision will be based on performance on the complete 75K test set along with provided documentation of the proposed approach by the teams.

### Submission Requirements:

1. Upload a `test_out.csv` file in the Portal with the exact same formatting as `sample_test_out.csv`

2. All participating teams must also provide a 1-page document describing:
   - Methodology used
   - Model architecture/algorithms selected
   - Feature engineering techniques applied
   - Any other relevant information about the approach
   Note: A sample template for this documentation is provided in Documentation_template.md

### **Academic Integrity and Fair Play:**

** ⚠️ STRICTLY PROHIBITED: External Price Lookup**

Participants are **STRICTLY NOT ALLOWED** to obtain prices from the internet, external databases, or any sources outside the provided dataset. This includes but is not limited to:
- Web scraping product prices from e-commerce websites
- Using APIs to fetch current market prices
- Manual price lookup from online sources
- Using any external pricing databases or services

Enforcement:
- All submitted approaches, methodologies, and code pipelines will be thoroughly reviewed and verified
- Any evidence of external price lookup or data augmentation from internet sources will result in **immediate disqualification**

Fair Play: This challenge is designed to test your machine learning and data science skills using only the provided training data. External price lookup defeats the purpose of the challenge.

### Tips for Success:

- Consider both textual features (catalog_content) and visual features (product images)
- Explore feature engineering techniques for text and image data
- Consider ensemble methods combining different model types
- Pay attention to outliers and data preprocessing

PROJECT SUBMISSION TEMPLATE

# ML Challenge 2025: Smart Product Pricing Solution Template

Team Name: [Your Team Name]
Team Members: [List all team members]
Submission Date: [Date]

## 1. Executive Summary
Provide a brief 2-3 sentence overview of your approach and key innovations.

## 2. Methodology Overview

### 2.1 Problem Analysis
Describe how you interpreted the pricing challenge and key insights discovered during EDA.

Key Observations:

### 2.2 Solution Strategy
Outline your high-level approach (e.g., multimodal learning, ensemble methods, etc.)

Approach Type: [Single Model / Ensemble / Hybrid, etc]
Core Innovation: [Brief description of your main technical contribution]

## 3. Model Architecture

### 3.1 Architecture Overview
Describe your model architecture with a simple diagram or flowchart if possible.

### 3.2 Model Components

Text Processing Pipeline:
- [ ] Preprocessing steps: []
- [ ] Model type: []
- [ ] Key parameters: []

Image Processing Pipeline:
- [ ] Preprocessing steps: []
- [ ] Model type: []
- [ ] Key parameters: []

## 4. Model Performance

### 4.1 Validation Results
- **SMAPE Score:** [your best validation SMAPE]
- **Other Metrics:** [MAE, RMSE, R^2 if calculated]

## 5. Conclusion
Summarize your approach, key achievements, and lessons learned in 2-3 sentences.

## Appendix

### A. Code artefacts
Include drive link for your complete code directory

### B. Additional Results
Include any additional charts, graphs, or detailed results

Note: This is a suggested template structure. Teams can modify and adapt the sections according to their specific solution approach while maintaining clarity and technical depth. Focus on highlighting the most important aspects of your solution.

THANK YOU!!!