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# Hyper-Personalized Product Recommendation Engine with Emotion Detection

**Abstract**

This project showcases a hyper-personalized product recommendation engine enhanced with real-time emotion detection capabilities, developed using the Orange data mining tool. By leveraging multi-modal data inputs—textual reviews and product images—the system predicts the most emotionally relevant products for a user. Sentiment analysis on user-generated text reveals emotional tone, while image embeddings extracted via CNNs represent products in a high-dimensional visual space. Machine learning models such as K-Means clustering and SVM classification are applied to match users with products aligned with their emotional context. Orange’s visual workflow enables a seamless combination of preprocessing, data transformation, model training, evaluation, and visualization.

# Problem Statement

Traditional recommendation engines focus mainly on historical user behavior—such as browsing history or purchase records—but ignore the user's current emotional state. This often leads to irrelevant or poorly timed suggestions. An emotionally intelligent system, which takes into account a user's mood or sentiment at the time of interaction, could provide more relevant, timely, and satisfying recommendations, improving user engagement and overall experience.

# Proposed Solution

The project introduces a hybrid solution that combines sentiment detection and visual product analysis to deliver hyper-personalized recommendations. The core components include:  
- Text-Based Sentiment/Emotion Detection: Uses NLP to analyze user text and detect emotions.  
- Image-Based Feature Embedding: Utilizes a CNN to convert product images into embeddings.  
- Clustering and Classification: Applies K-Means for grouping and SVM for predicting preferences.  
- Visualization: Displays emotion-based clusters and predicted recommendations.

# Technologies & Tools Used

1. Orange Data Mining – Visual pipeline creation and model training  
2. Sentiment Analysis – To extract user emotions from text  
3. Image Embedding – Feature extraction using CNN  
4. PCA – Dimensionality reduction of embeddings  
5. K-Means – Clustering based on emotional similarity  
6. SVM – Classification for product prediction  
7. Visualization – Box, bar, and scatter plots for evaluation

# Workflow Explanation

The system was built using five major Orange pipelines:

1. Text-Based Emotion Detection:  
 - File → Select Columns → Corpus → Preprocess Text → Sentiment Analysis → Data Table  
 - This stage reads user feedback, cleans the text, and extracts emotional tone.  
  
2. Image-Based Feature Embedding:  
 - Import Images → Image Embedding → Select Columns → Edit Domain  
 - CNN extracts visual characteristics to represent each product in vector form.  
  
3. Feature Engineering:  
 - Data Sampler → PCA  
 - Reduces embedding dimensions for efficient classification and visualization.  
  
4. Clustering and Classification:  
 - Merge Data → K-Means & SVM  
 - Combines emotion and image features to group similar users/products and classify suggestions.  
  
5. Predictions and Evaluation:  
 - Predictions → Box Plot, Bar Plot, Scatter Plot  
 - Visual analytics to assess the quality and accuracy of recommendations.

# Key Outputs

- Emotion-Aware Product Lists  
- Emotion Distribution Charts (bar, pie)  
- Clustered Segments of Users/Products  
- Model Evaluation Metrics like accuracy, confusion matrix, classification report

# Challenges Encountered

1. High-dimensional embeddings: Solved using PCA for dimensionality reduction.  
2. Missing emotion labels: Enriched dataset with synthetic tags.  
3. Feature misalignment: Used SVM for better mapping.  
4. Tool limitations: Embedded Python scripts within Orange for custom models.

# Future Scope

- Incorporate real-time facial or voice-based emotion recognition.  
- Extend system to process streaming data for dynamic updates.  
- Build a web UI for direct product suggestions.  
- Deploy via REST API for integration with e-commerce platforms.

# Conclusion

The project successfully merges emotional intelligence with recommendation logic using Orange’s intuitive platform. By integrating textual and visual data, the system delivers precise and context-aware product recommendations. With future enhancements such as real-time detection and integration into live systems, the model could significantly improve user experience in digital marketplaces.

# Workflow Diagram

Below is the complete Orange workflow pipeline used in the project:

