

Task for ML Intern

Objective

This assignment assesses your ability to process hyperspectral imaging data, perform dimensionality reduction, and develop a machine learning model to predict mycotoxin levels (e.g., DON concentration) in corn samples.

Problem Statement

You are provided with a compact hyperspectral dataset containing spectral reflectance data from corn samples across multiple wavelength bands. Your task is to:

- Preprocess the data (e.g., handle missing values, normalize features).
 - Visualize spectral bands to explore data characteristics.
 - Reduce dimensionality using PCA or t-SNE and interpret the results.
 - Train a machine learning model (e.g., Random Forest, XGBoost, or a simple neural network) for regression.
 - Evaluate the model and present actionable insights.
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Dataset Description

- Features: Spectral reflectance values across multiple wavelength bands (columns).
 - Rows: Individual corn samples.
 - Target Variable: DON concentration (continuous, for regression).
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Tasks

1. Data Exploration and Preprocessing

- Load the dataset and inspect for missing values, outliers, or inconsistencies.
- Apply normalization or standardization to the spectral data as needed.
- Visualize spectral bands (e.g., line plots for average reflectance, heatmaps for sample comparisons).

2. Dimensionality Reduction

- Implement Principal Component Analysis (PCA) or t-SNE to reduce feature dimensions.
- Report the variance explained by the top principal components (for PCA) or clustering patterns (for t-SNE).
- Visualize the reduced data (e.g., 2D/3D scatter plots).

3. Model Training

- Select a model: Deep Learning, CNN, GNN, or LSTM.
- Split the dataset into training (e.g., 80%) and testing (e.g., 20%) sets.
- Train the model and optimize hyperparameters (e.g., using grid search or random search).

4. Model Evaluation

- Evaluate using regression metrics:
 - Mean Absolute Error (MAE)
 - Root Mean Squared Error (RMSE)
 - R² Score
 - Visualize results:
 - Scatter plot of actual vs. predicted values (regression).
 - Summarize model performance and limitations.
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Deliverables

Submit a GitHub repository containing:

1. Jupyter Notebook or Python Script:
 - Clean, modular, and well-commented code covering all tasks.
 2. Short Report (1-2 pages, PDF or Markdown):
 - Preprocessing steps and rationale.
 - Insights from dimensionality reduction.
 - Model selection, training, and evaluation details.
 - Key findings and suggestions for improvement.
 3. README File:
 - Instructions to install dependencies and run the code.
 - Brief overview of the repository structure.
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Evaluation Criteria

- Code Quality (30%): Clean, organized, and documented code.

- EDA & Visualization (25%): Effective data exploration and clear visualizations.
 - Model Performance (25%): Appropriate model choice, training, and evaluation.
 - Interpretability (20%): Insightful explanations and improvement ideas.
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Bonus (Optional)

- Implement an attention mechanism, or transformer and compare performance.
 - Create a Streamlit app for interactive predictions from user-uploaded spectral data.
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Submission Guidelines

- Deadline: March 14, 2025
 - Submission: Email the GitHub repository link to satyam.kumar@imagoai.com.
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Tips for Success

- Focus on clarity and simplicity in your approach.
- Justify your choices (e.g., preprocessing techniques, model selection).
- Highlight trade-offs or challenges encountered.

Good luck, and we look forward to your submission! 🚀