CSE 623 ML Project Report Week-1
Project Name: A Traditional Machine Learning Pipeline for Robust Wheat Counting in Multi-Object Field Scenes
Group Name: Gradient Descent

Objective

The objective of Week 1 was to perform a detailed analysis of the dataset structure, annotation format, metadata, and inherent challenges before proceeding to feature extraction and model development.

Dataset Overview

The dataset consists of:

- Training images: 3657
- Validation images: 1476
- Testing images: 1382
- Total images: 6515

The dataset size is approximately 10GB, indicating high-resolution image data.

Image Characteristics

After inspecting multiple images:

- Resolution: 1024 × 1024 pixels

- Channels: 3 (RGB)
- Uniform image size across dataset
- High-resolution agricultural field scenes

Annotation Structure

Each subset (train, validation, test) contains a CSV file with:

- image_name
- BoxesString
- Domain

The BoxesString field contains multiple groups of four numerical values. Example: 99 692 160 764; 641 27 697 115; … where each group represents (xmin,ymin,xmax,ymax). This confirms the dataset is structured for object detection.Also, each image may contain multiple wheat heads where counting can be derived by calculating the number of bounding box groups per image.

Annotation Density Observations

From inspection of the training CSV:

- The majority of images contain multiple bounding boxes.
- Several images contain dense clusters of wheat heads.
- A small number of images contain the label “no_box” indicating negative samples.
- Some images contain only 1–2 wheat heads.

This shows:

- High variation in object density.
- Class imbalance between sparse and dense images.
- Need for robust detection models capable of handling occlusion and clustering.

Metadata Analysis

The metadata dataset contains the following columns:

- name
- country
- location
- development_stage

Observations:

- Images are collected from multiple countries (Switzerland, UK, Belgium, Norway, France, Canada, Japan, etc.).
- Multiple development stages are present (Filling, Ripening, Post-flowering, etc.).
- This introduces variability in:
    - Lighting
    - Wheat appearance
    - Texture patterns
    - Growth stage morphology

This increases the complexity of building a generalized and robust counting model.

Conclusion of Week 1

Week 1 was dedicated to:

- Structural dataset analysis
- Annotation format understanding
- Bounding box interpretation
- Dataset split verification (6515 total images)
- Metadata inspection
- Identification of technical challenges

This foundational understanding will guide feature extraction selection and model development in upcoming weeks.

Plan for Week 2

In the upcoming week, we will focus on studying and implementing classical feature extraction techniques including SIFT, HOG, GLCM, and LBP, along with basic contour-based analysis. These methods will be applied to a subset of the training images to evaluate their effectiveness in detecting and distinguishing wheat heads under varying density and lighting conditions. Additionally, relevant research papers on feature extraction for object detection will be reviewed to guide the implementation strategy for subsequent phases of the project.