PlantCLEF2025 @ LifeCLEF & CVPR-FGVC

Multi-label Plant Species Prediction from Quadrat Images

Team NEXORA

M. I. NADHA 220409J

M. M. M. MUFTEE 220399B

Multi-label Plant Species Prediction from Quadrat Images

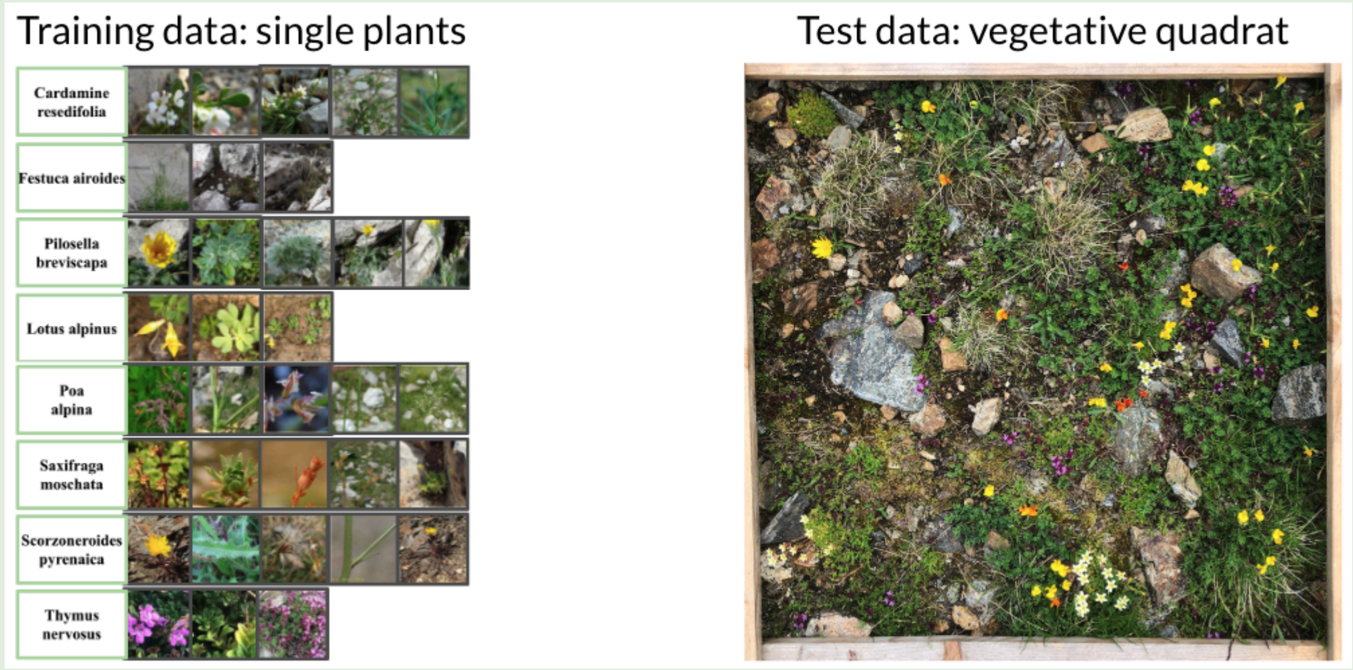
Training Data:

1.4 million single species images

covering 8.4k plant species

Test Data:

2105 vegetation quadrat images

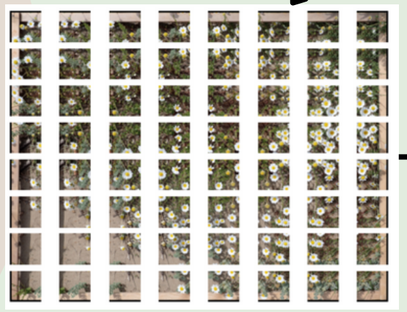


Problem Statement

The domain-shift between single-label training images and multi-label test images

Approach

Quadrat Image → Pytorch tensor



Split into tiles

PreProcessing

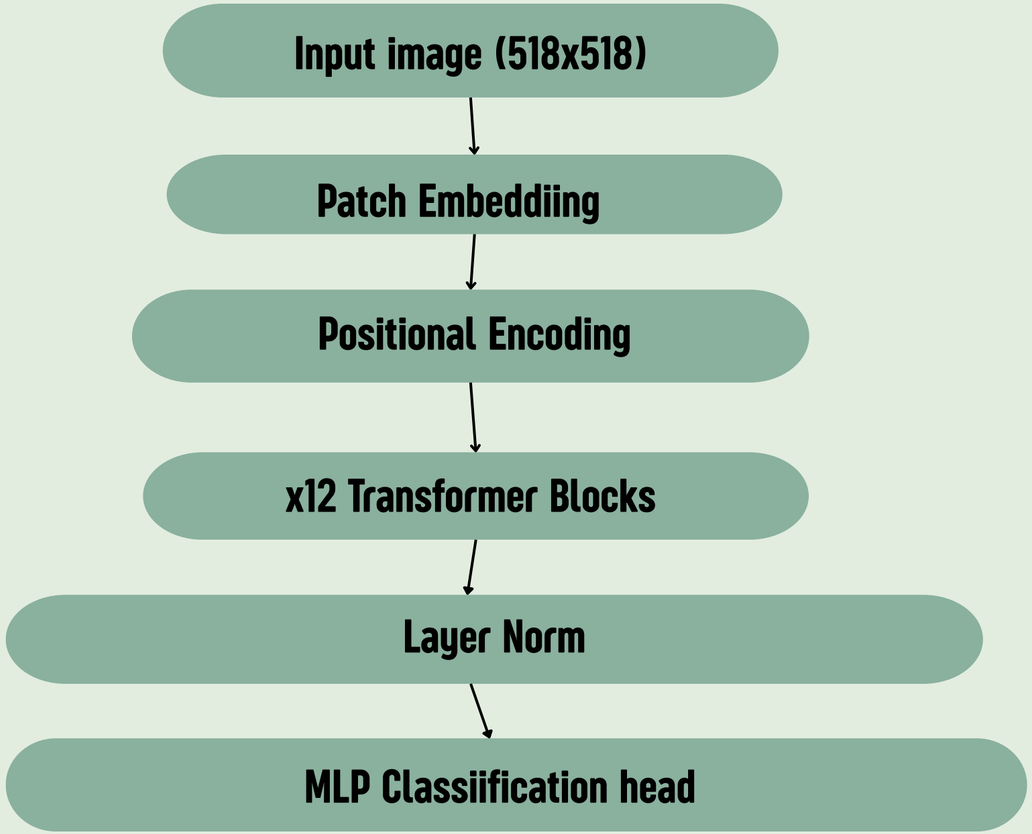
Binary Classifier
(Plant vs non plant artifacts)

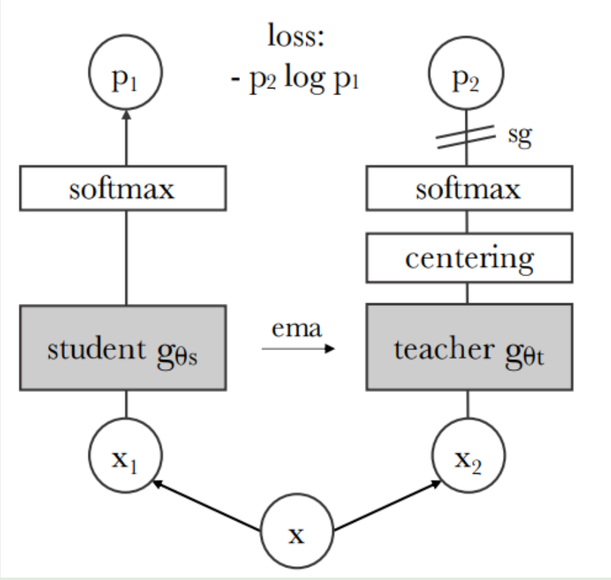
DINOv2+MLP classifier

Tile aggregation and thresholding

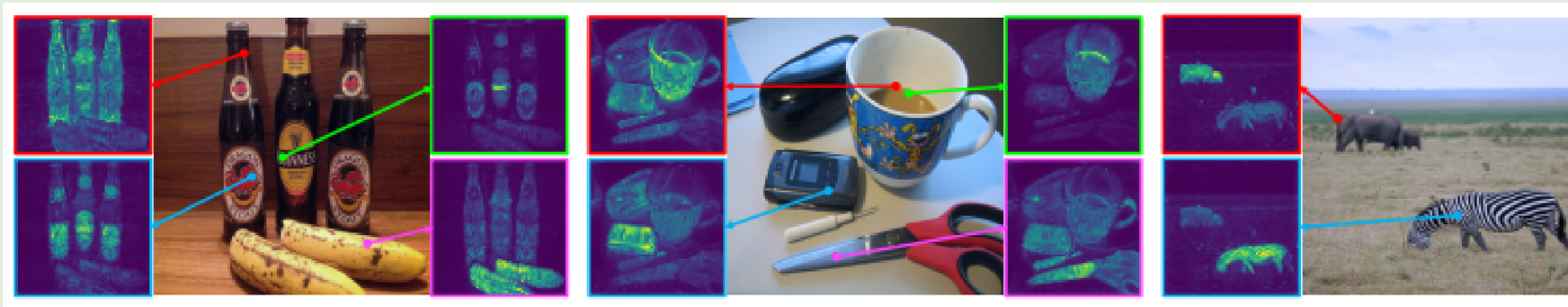
Quadrat level species

Backbone: DINOv2 ViT





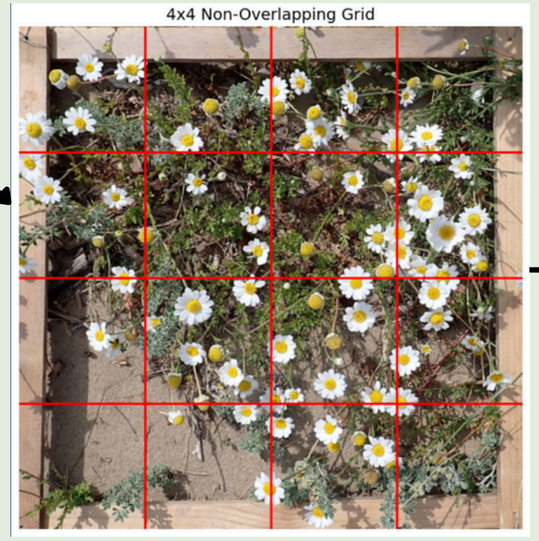
- DINO = Distillation with No Labels
- It's a self-supervised learning method:
  - Train a vision model without labels.
  - The model learns useful representations by comparing different views (augmentations) of the same image.

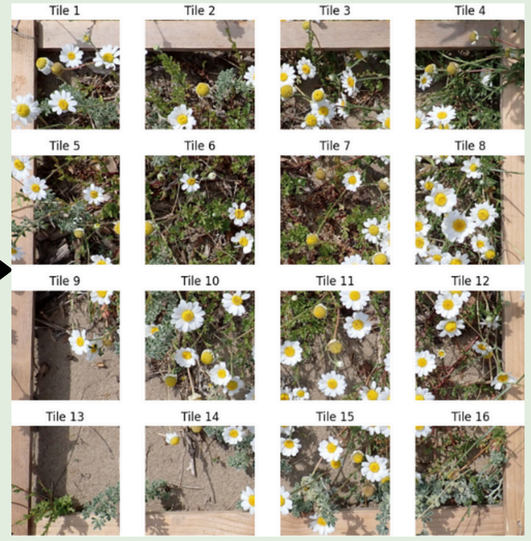


Tiled Inference

1. Sliding Window Tiling (Overlapping)

2. Fixed Grid Tiling (Non overlapping)

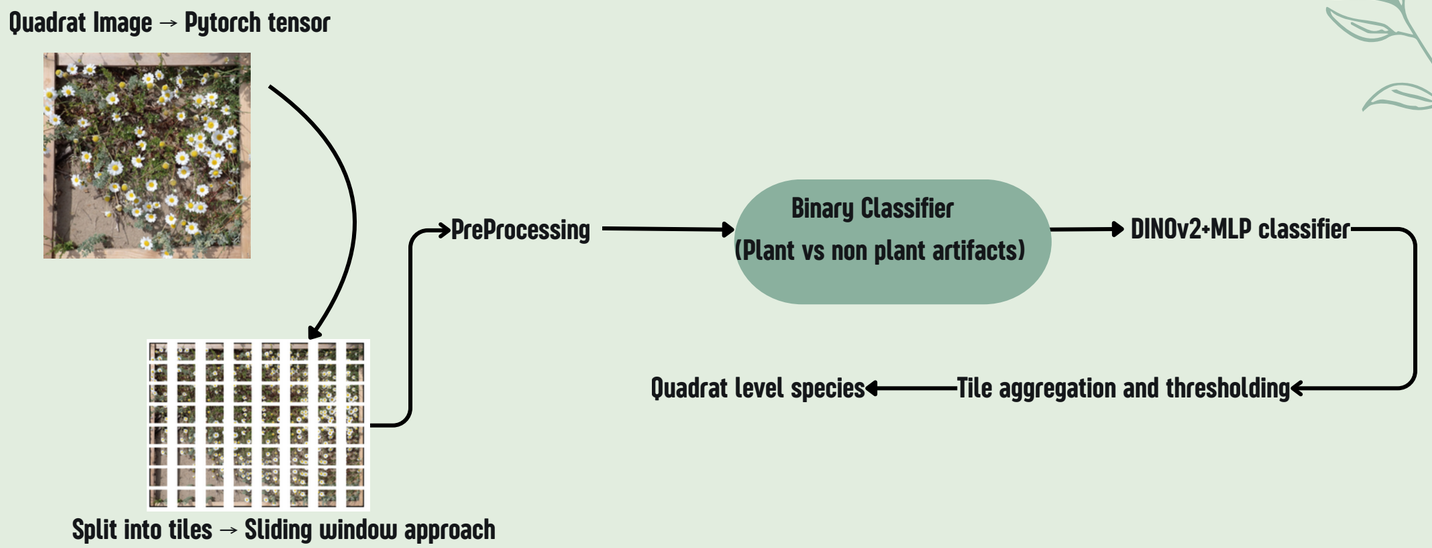




Binary Classifier

To reduce false positives caused by the non plant regions, a binary classifier will be employed to distinguish plant vs. non-plant regions.

- Dataset: A separate collection of non-plant images will be used alongside plant tiles.
- Methods to be tested:
  - Logistic Regression
  - Random Forest
  - ViT-based classifier



Top k predictions with softmax

Model output logits

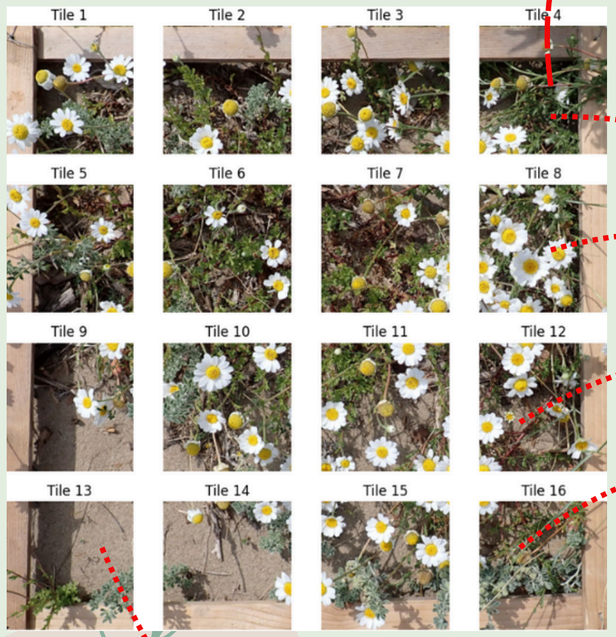
Softmax

Probabilities

Top K classes

Minimum score

Species predicted



Logit averaging

Model output logits

Average per species

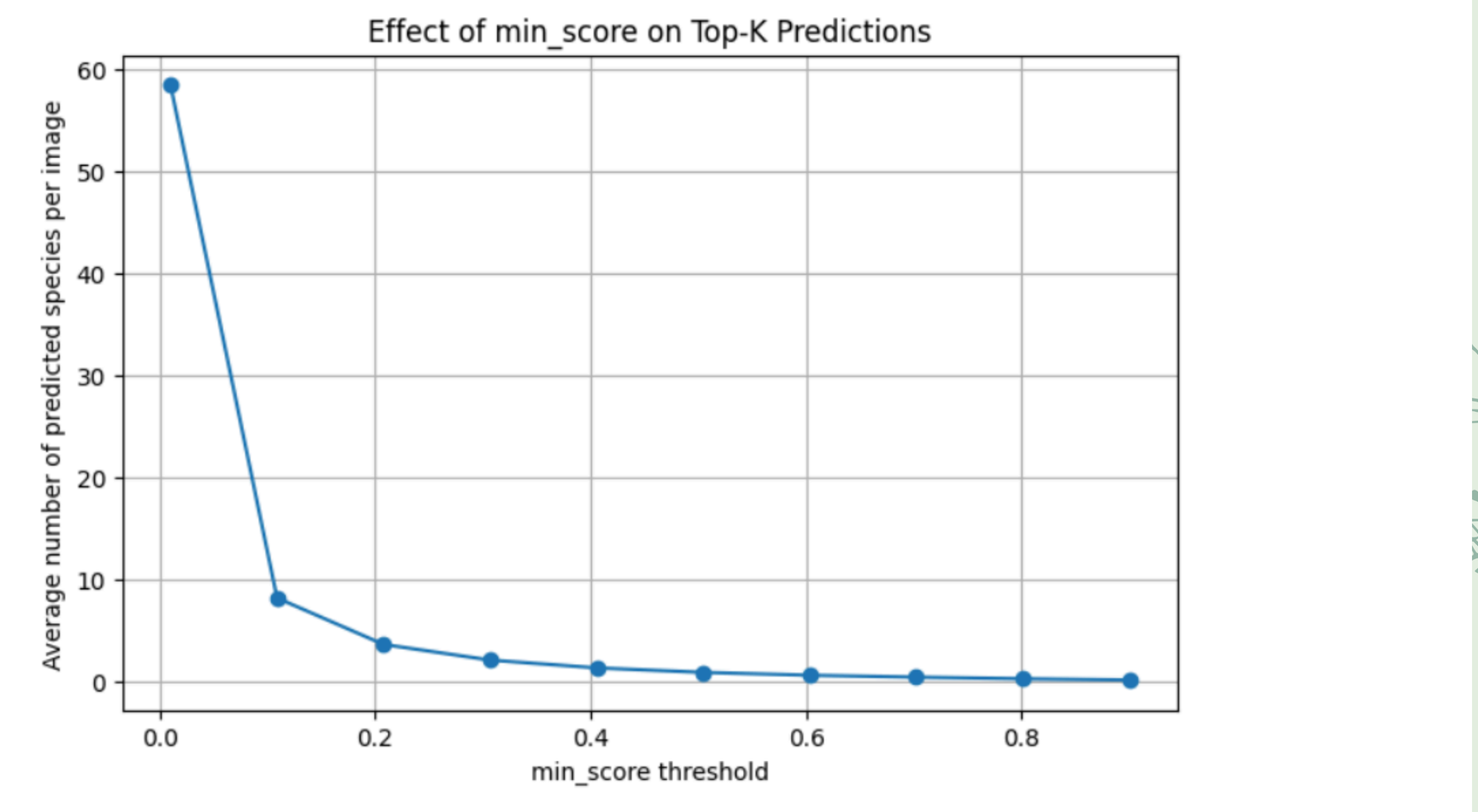
Softmax

Aggregation across tiles

Weighted Logit averaging

Maximum softmax probability x Model output logits

Minimum score vs the average number of predicted species per image



Evaluation Metrics

Example on a test quadrat image:

Ground truth:

Cardamine resedifolia L.
Festuca airoides Lam.
Pilosella breviscapa (DC.) Soják
Lotus alpinus (Ser.) Schleich. ex Ramond
Poa alpina L.
Saxifraga moschata Wulfen
Scorzoneroides pyrenaica (Gouan) Holub
Thymus nervosus J.Gay ex Willk

Predictions:

2 True positives (correct):
- Poa alpina L.
- Saxifraga moschata Wulfen

3 False positives (incorrect):
- Cardamine amara L.
- Lotus corniculatus L.
- Scorzoneroides montana (Lam.) Holub

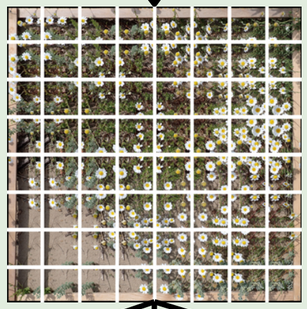
5 False negatives (missing):
- Festuca airoides Lam.
- Pilosella breviscapa (DC.) Soják
- Lotus alpinus (Ser.) Schleich. ex Ramond
- Thymus nervosus J.Gay ex Willk

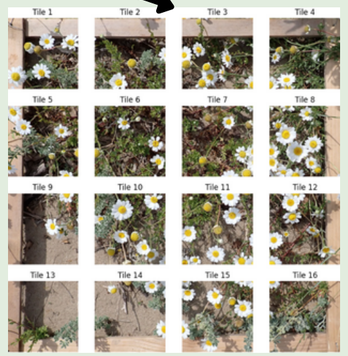
$$\text{Precision}_j = \frac{\text{TP}_j}{\text{TP}_j + \text{FP}_j} = 2/(2+3) = 0.4$$

$$\text{Recall}_j = \frac{\text{TP}_j}{\text{TP}_j + \text{FN}_j} = 2/(2+5) = 0.286$$

$$\text{F1}^j = \frac{2 \cdot \text{Precision}_j \cdot \text{Recall}_j}{\text{Precision}_j + \text{Recall}_j} = 0.333$$

Prediction Scores





DINOv2+MLP classifier

Score: 0.11871
Public score: 0.11295

Top K prediction with softmax

Min score	Score	Private score
0.3	0.32052	0.29644
0.5	0.30418	0.30155
0.7	0.22904	0.25469

Logit Averaging

Min score	Score	Private score
0.2	0.09655	0.13010
0.05	0.17028	0.21437
0.01	0.21495	0.24895

Weighted Logit Averaging

Min score	Score	Private score
0.01	0.22333	0.25534
0.05	0.21376	0.25965

Min score

Min score	Score	Private score
0.3	0.31630	0.31019
0.5	0.28982	0.28410