Members

Noshen Habib (noshen@berkeley.edu) (git: noshen-atashe)
Jeremy Cui (jaycray0987@berkeley.edu) (git: jcui2001)
Daniel Motoc (daniel_motoc@berkeley.edu) (git: danmot-98)

Motivation

Fungi are a critical part of ecosystems, playing roles in decomposition, nutrient cycling, and biodiversity. Yet identifying fungal species is notoriously difficult, even for experts, because many species differ only in subtle morphological traits such as cap color, stem thickness, or gill spacing. Automated fungal recognition systems could support ecological research and biodiversity monitoring, but fine-grained image classification alone remains a challenge due to intra-species variation, visual similarity, and noisy outdoor conditions.

Does incorporating simple ecological metadata (e.g., collection date and location) alongside images improve fungal classification accuracy compared to image-only models?

This is an important question because fungal appearance is influenced by seasonality and geography, and leveraging this additional context may reduce common misclassifications.

Data

We will use the **FungiTastic dataset**, a large-scale resource for fungal recognition built from the *Atlas of Danish Fungi*:

- **Scale & scope**
  - ~350,000 observations and ~650,000 images
  - 5,000 fungal species collected over two decades
  - Expert-curated labels, with a DNA-verified subset (~2,000 observations)
- **Observation contents**
  - 1+ photographs per observation (some include microscopic spore images)
  - Full taxonomic labels (species + higher taxonomy)
  - Metadata: location, time of year, habitat
- **Special modalities**
  - ~70,000 observations include segmentation masks (gills, caps, stems, pores)
  - Remote sensing geospatial data for European observations
  - Meteorological data for each observation site
- **Project scope**
  - For feasibility, we will focus on images + basic metadata (location and month)
  - This subset keeps the project manageable while still leveraging multimodal richness

Related Work

The key related work we will be referencing is the FungiTastic Dataset Paper, *FungiTastic: A Multi-Modal Dataset and Benchmark for Image Categorization.* The authors benchmarked several CNN and transformer models on the dataset and found that incorporating metadata improved classification, particularly for rare species.
While the FungiTastic benchmark has demonstrated that including metadata can improve fungal classification, the specific benefits of metadata fusion are not yet fully characterized. In particular, it remains unclear which metadata features are most valuable, how they interact with visual features, and whether they improve performance equally across common and rare species. My project will focus on this gap, systematically comparing image-only and image+metadata models to provide a clearer understanding of the role of contextual information in fungal recognition.

Methodology

This project will proceed in three stages. First, we will clean and prepare the data by removing duplicates, filtering low-quality images, and standardizing resolution. Metadata such as month and location will be checked for consistency and transformed into usable features (e.g., cyclical encoding for time, categorical regions for location). Data augmentation (random crops, flips, color jitter) will be applied to improve generalization.

Next, we will train image-only baselines using pretrained CNNs (ResNet-50, EfficientNet) and Vision Transformers (ViT), then extend these models with multimodal fusion by concatenating image embeddings with metadata features through a multilayer perceptron.

Finally, we will conduct error analysis with confusion matrices and Grad-CAM visualizations to evaluate performance and interpret model focus on fungal structures.

Project Github Repository

https://github.com/UC-Berkeley-I-School/fungitastic-classification-datasci207-Fall-2025