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Computer Vision Course Project: A Plant Identification Web App

by

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Abstract:

For this report, I developed a web application for plant identification, leveraging the Resnet34 model with a softmax layer to classify species from user-uploaded images, inspired by the Pl@ntNet-300K dataset. This endeavor was aimed at replicating Pl@ntNet's functionality within a web-based interface using Python and Flask. A few image examples were tested on the web application and the results are discussed in this report. The project served as a practical exploration into the integration of machine learning models into user-friendly applications.

1 Introduction

Pl@ntNet is a project that trains a plant identification system based on photographic observations of plants from its users. The website features a page that allows users to upload an image of a plant and provides the top predictions for species as well as their probabilities [3].

In 2021, Garcin et al. published a paper in which they created a dataset called Pl@ntNet-300K, which was a subset of the Pl@ntNet citizen observatory database. The dataset contains 306,146 plant images covering 1,081 species and exhibits high ambiguity and a long-tailed distribution, meaning the classes are similar and a small subset of the classes represent a majority of the images [1].

The goal of this report is to attempt to replicate the fundamental functionality of the Pl@ntNet identification system. The authors of the Pl@ntNet-300K paper have a repository on GitHub containing the Python code as well as the model weights for recreating the results of the paper [2].

2 Methods

The project consists of a web application written in Python, using the Flask library for the server. The architectural style is that of a RESTful API. PyTorch was used to load and run the classification model on the backend. The user interface is a web page that accepts an image, sends it to the server, and displays the results.

The classification model is Resnet34, loaded with the weights provided by Garcin et al. [2]. A softmax layer was appended to the model in order to show probabilities in the output.

The source code for the project is available at:
https://github.com/DavidHTwastaken/plant-classifier

3 Results

The Pl@ntNet-300K dataset was uploaded to Hugging Face [4], which enables the viewing of class breakdowns as well as downloading individual images. Some example images from the test set were used to test the web application. Figure 1

shows an example from the most common species in the training set: St. John's Wort (Hypericum perforatum L.). As expected, the probability associated with the correct species is very close to 100%. However, Figure 2 shows the results for Acacia senegal. This species is one of the least common in the training set, which is why the correct species is not present in the top 4 predictions. The difference in performance between Figure 1 and Figure 2 illustrates the effect of the distribution of Pl@ntNet-300K. Since St. John's wort has 6,140 images in the training set and Acacia senegal has 2, the model is far more accurate when identifying the former.

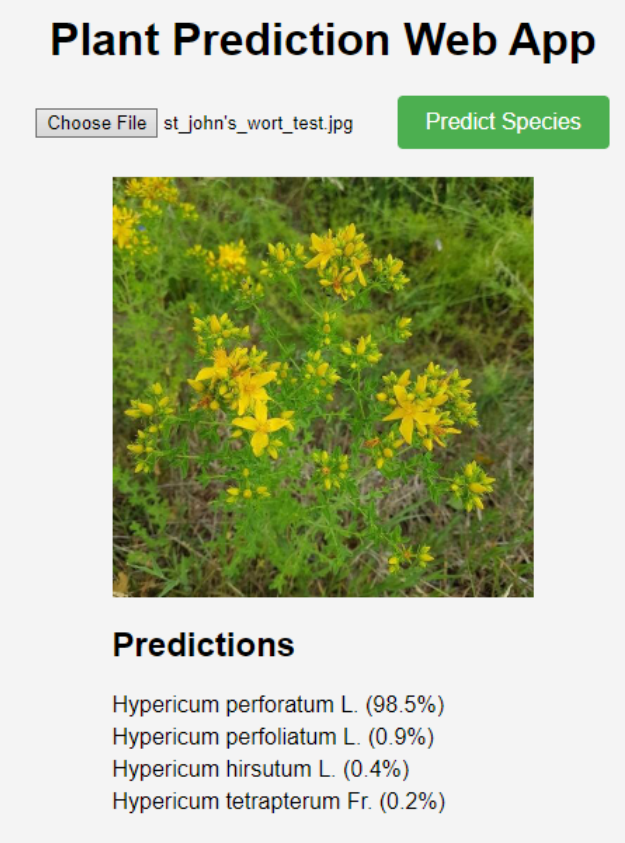

Figure 1: Prediction for image of St. John's wort. The image comes from the test set for Pl@ntNet-300K. This species is the most common in the training set.

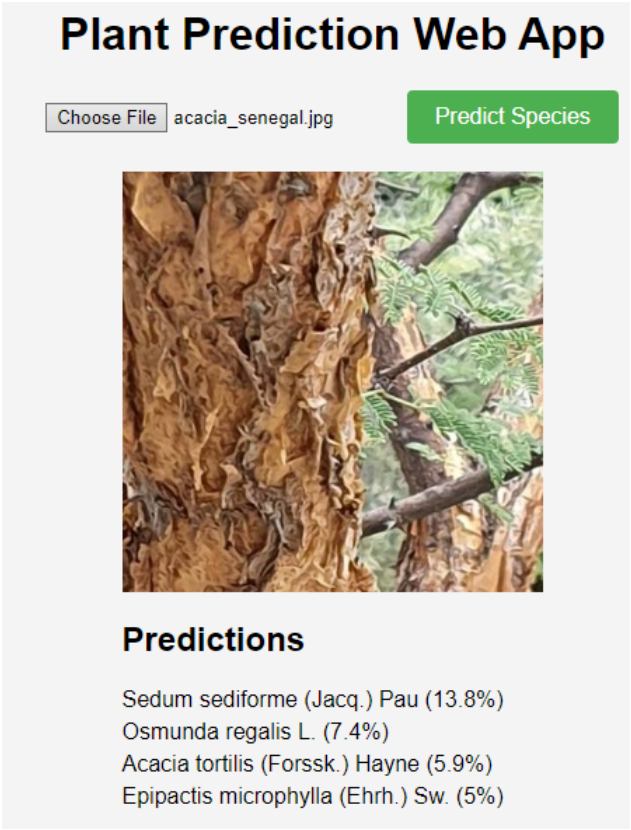

Figure 2: Prediction for image of Acacia senegal from the test set of Pl@ntNet-300K. This species is one of the least common in the training set.

4 Conclusions

In this report, I built a web application with Flask and PyTorch that mimics Pl@ntNet's plant identification system. The importance of data and scale when training models was shown through examples of the identifier's output. The performance of the Resnet34 model used in the web application is heavily biased because of the nature of the Pl@ntNet-300K dataset. However, the web application overall demonstrates that even small teams can leverage open source models to create features for users.

References

[1] C. Garcin et al. “Pl@ntNet-300K: a plant image dataset with high label ambiguity and a long-tailed distribution”. In: *NeurIPS Datasets and Benchmarks 2021*. 2021.

[2] Camille Garcin. *Plantnet/plantnet-300K: [neurips2021] a plant image dataset with high label ambiguity and a long-tailed distribution*. Mar. 2024. URL: https://github.com/plantnet/PlantNet-300K.

[3] URL: https://identify.plantnet.org/.

[4] Mike Hemberger. *mikehemberger/Plantnet300k*. URL: https://huggingface.co/datasets/mikehemberger/plantnet300K.