Cicada Zombies: Photo Recognition via Machine Learning

Prayagdeep Parija, Douglas Stauffer, Wojciech Tralle, Henry Tucker

June 2, 2024

1 Introduction

This spring, two broods of periodical cicadas will emerge in parts of the South and the Midwest singing their love songs. The Great Southern Brood (Brood XIX) and the Northern Illinois Brood (XIII) have not co-emerged since 1803, when Thomas Jefferson was president.

The periodical cicadas are susceptible to an infection by the fungus Massospora cicadina. During infection, the fungus takes control of the cicadas' behaviour, making them into "zombies" that spread the fungus spores. The fungus grows concealed in the abdomen of the cicada, and eventually the rear part of the abdomen falls off to reveal a "plug" of spore-producing fungus. This fungus plug is nicknamed the "salt shaker of death" since the flying "zombie" cicadas spread the spores over the ground.

Besides the general interest to entomologists and mycologists, determining infection status of cicadas is also important for drug researchers and climate change scientists. The infected cicadas produce psilocybin, the active ingredient in hallucinogenic mushrooms, which is of interest to developers of psychiatric drugs. Since cicadas evolved millions of years ago, they have also survived through several big changes to the earth's climate. The cicadas' emergence is controlled by soil temperature, hence they provide an important point of study for researchers.

This project will use image recognition to determine the infection status of photographed cicadas. This disease is visually apparent from specimens within these broods.

2 Dataset and Approach

We apply several convolution neural networks to data sets of images from iNaturalist and images.cv labeled by infected or healthy. The goal is to evaluate these models based on loss and accuracy. The models used were VGG16, VGG19, and Inception2.

3 Stakeholders

- Pharmaceutical research scientists investigating psychoactive drugs
- Climate change scientists
- Entomologists
- Mycologists
- Cicada enthusiasts

4 Key Performance Indicators (KPIs)

- Model prediction accuracy
- Model prediction precision
- Model prediction recall