# The Aviary Project: An Analysis of Cowbird Behavior with a Focus in Automated Action Classification

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## Overview

The Penn Aviary project is one that brings together biologists and engineers in order to study bird behavior with the help of computer science. The lab collects data via a "smart aviary" that is equipped with 10 cameras and 24 microphones. The various branches of the lab are outlined below:

- Vision: working to automatically detect the location and poses of birds and eventually map the trajectory of each identity in a 3D space
- Sound: working to automatically isolate the sound of bird songs and eventually map vocal patterns using machine learning
- Behavior: working to analyze patterns in bird behavior, both individually and pairwise, and eventually combine data sets produced by the aforementioned branches to uncover patterns that go beyond the scope of the human eye

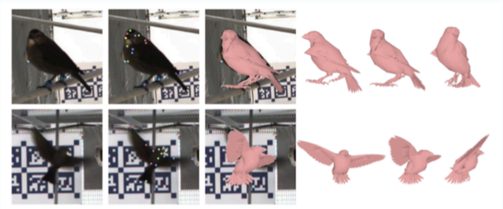
The research was new for most if not all of us, so a necessary component to the summer program was preliminary research. We began with presentations and lab meetings from both professors about the work done in the lab and it was split into two main topics:

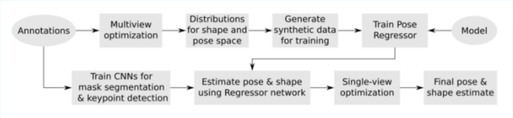
- The computer vision and the analysis pipeline for it
- The behavior and biology of the birds themselves

After the first week or so of listening, we were each assigned a research paper that was closely related to the work we were doing in the lab, and we had to present the contents of the reading to the rest of the group in two-hour long presentations

## Deep Dive

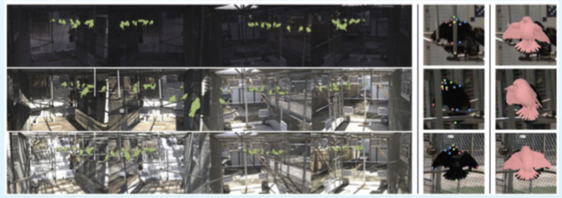
For the second half of the summer we engaged in individual projects which we called "Deep Dives". These were intentional research projects on specific areas of the analysis pipeline that were of particular interest to us: Song analysis/classification, tracking, action classification, and behavioral analysis. It was a deep dive because rather than be explicitly taught, we had to do the research individually and at a much deeper level of understanding than with the preliminary research. We each read 3-5 articles from scientific journals, and then put together hour long presentations for the rest of the group.
After our presentations, we got into the actual process of "conducting the research" which for us wasn't so much about running experiments as it was about making a contribution to the overall process that would enable future data collection and analysis. We were tasked with creating annotated datasets which could be used to draw some conclusions about the behavior of the birds, and also to train an action classifier for automated analysis.





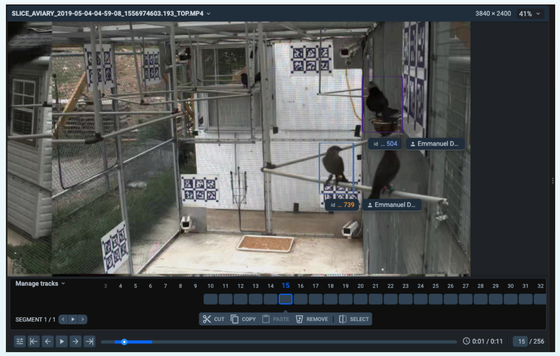

## Part 1: Research

For my Deep Dive, I worked with a peer to focus on pose estimation, tracking, and action classification. Specifically, I looked into five articles on action classification, looking specifically for network models with a novel feature that could be applied with the current Mask rCNN we use. This included learning python, understanding NumPy and PyTorch, and learning about coding environments and how they're used to run CNNs



## Part 2: Data Set Collection

For the second half of the deep dive component, and for what became the rest of my work this summer, we were tasked with creating a dataset to train our tracking algorithm. The task was to get a series of tracklets (trajectories of movement over time) for the birds by annotating their positions over a two-hour data collection period. Before this could be done, my peer Lauren had to create a program that could easily edit existing tracklets (see her poster to learn more about the program – it's pretty impressive!) While she made that, I created a ground truth data set to train an action classifier on whether the birds are singing or not singing by annotating existing videos with an app called Supervisely



## Moving Forward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## Acknowledgements