Summary of Research Progress Since the Last Report:

Feature representations for lab animal behavior modeling:
I wrote and **submitted a paper** to the conference Computer Vision and Pattern Recognition (CVPR). This paper is about using segmentation as an alternative / comparable method to keypoint detection in mouse abstraction for behavior. I am going to be presenting this work during the TAC.

Methods paper for using mmpose and benchmarking performance of foundational models:
I have been transitioning my model pipeline from a non-generalizable keypoint detection network, to a cutting-edge library called mmpose, capable of using various models. This project has expanded into a methods paper where I am developing a generalizable pipeline for converting keypoint detection from DeepLabCut or SLEAP to mmpose. I also explore the usage of foundational models and how they can improve performance + how they can be improved.

Grants:

- Applied to SIG-HPC fellowship – rejected
- Applied for schimmel fellowship – rejected
- Applied to ESIP fellowship – **received**
- Applied to AIM-AHEAD training programs – in review

Other things I have been involved in:

- Co-lead of the student-run Genetics Journal Club
- JAX graduate student council rep, Tufts student council rep
- Leading Tufts computational biology club

Summary of Research Plans for 2024 Spring TAC meeting:

Before the next TAC meeting in the Spring, I will be working to submit my homeostatic manuscript. We have been working to include another (final) behavior to the analysis which is huddling. I will also be finishing up the mmpose methods paper in the Winter/Spring and submitting that manuscript as well. Finally, I will be working on picking up the aged C57BL/6J maze data again, with an RA in the Spring running the final experiments needed. I will be running more analysis and developing it into a story and plan to present updated figures on that topic in the next TAC.

Highlights of Results:

Feature representations for lab animal behavior modeling:

This paper is focused on using segmentation as an alternative to keypoint detection for downstream behavior analysis. This analysis was originally performed on only the grooming behavior, then expanded to 8 behaviors total. I will include some of the figures below:

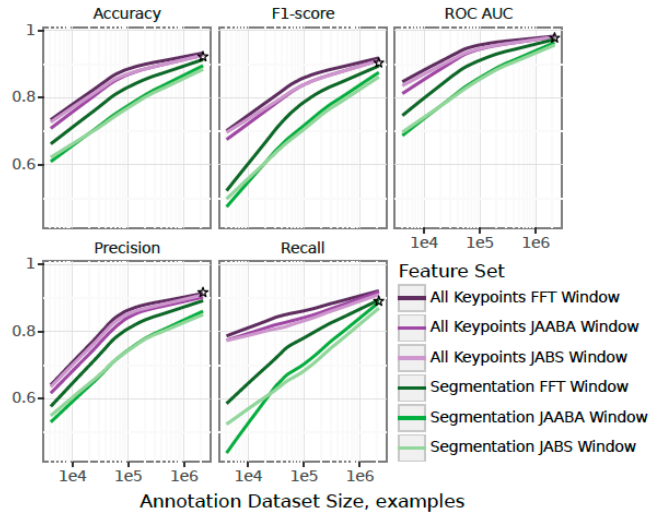

Figure 1. Scaling experiment for grooming classification task, comparing keypoint and segmentation features using different window features. Stars indicate CNN from [13].

Comparison of keypoints and segmentation performance when looking at large grooming training dataset. Different shades indicate different window features used. These window features introduce a temporal component into the classifiers and improves performance.

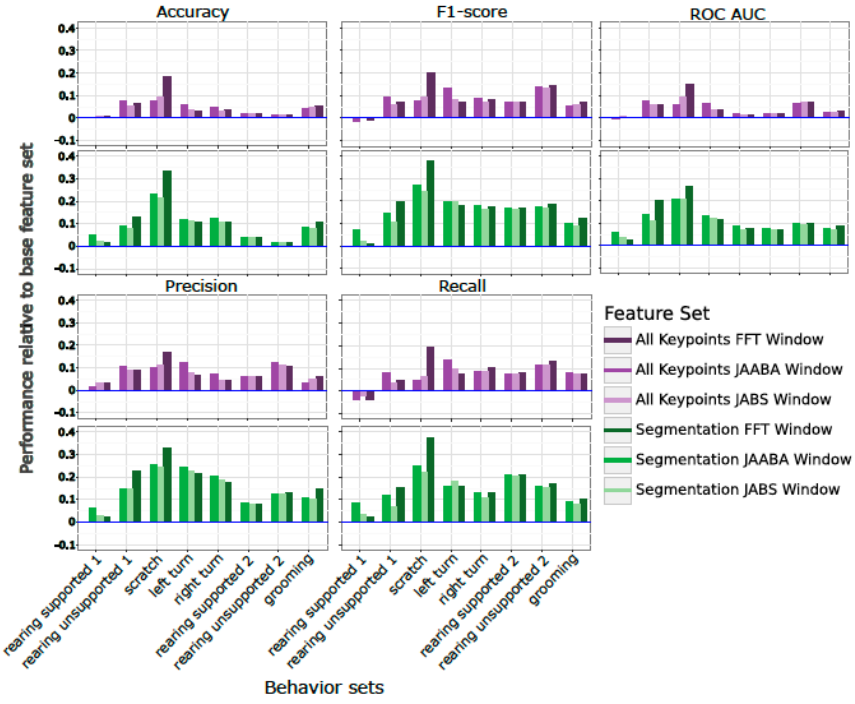

Figure 2. Experiment for additional benchmarks classification task, comparing keypoint and segmentation features using different window features. Bars are relative performance of window feature set compared to base feature set as baseline. Rearing supported 1 and rearing unsupported 1 benchmarks are from [1], while rearing supported 2 and rearing unsupported 2 benchmarks are from [37]

Expanding this analysis to the rest of the behaviors follows a similar trend, though is behavior-specific. These plots are the offset of performance in comparison to the base feature set (without any window features).

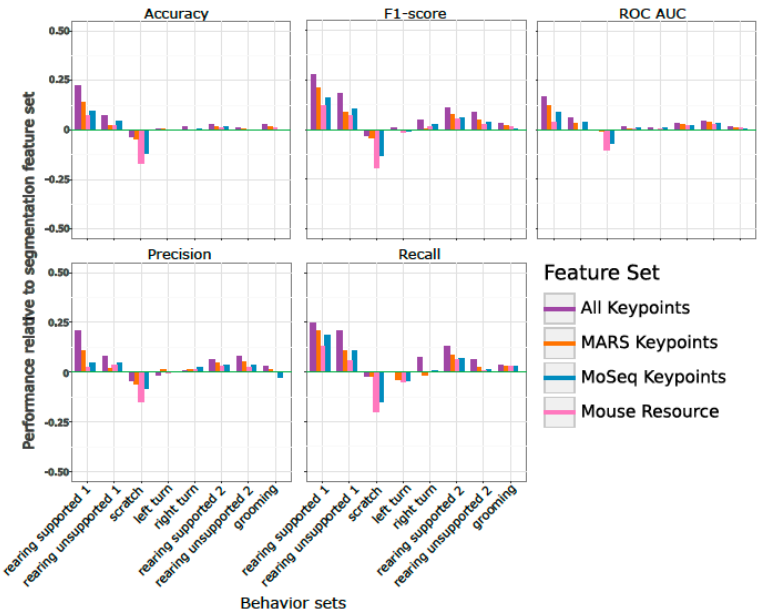

Figure 4. Relative performance metrics compare each keypoint subset with the segmentation feature set as baseline. Rearing supported 1 and rearing unsupported 1 benchmarks are from [1], while rearing supported 2 and rearing unsupported 2 benchmarks are from [37]. See Tab. 2 for keypoint subset descriptions.

Then we compared different keypoint subsets with a segmentation feature set as a baseline.

Our results show that performance difference with strictly segmentation features is very competitive.