LS100/MCB100 FALL 2021

PROJECT 3: COMPUTATIONAL ETHOLOGY

UNDERSTANDING ANIMAL BEHAVIOR BY APPLYING CUTTING-EDGE COMPUTATIONAL TOOLS

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SUMMARY

Why do animals do what they do? How do they do something that seems extraordinary? How similar are animals to each other or us? Do they have individual personalities? How can we read their (body) languages? How well can we predict their behavior? These and similar questions are of central focus in ethology, the scientific study of animal behavior. Ethological studies typically comprise observation of interesting behaviors in animals that evoke some testable question(s) - the hypothesis, and then testing the hypothesis by collecting and analyzing data.

GOAL OF THE COURSE: WHAT WILL YOU LEARN?

This course aims to make students comfortable with using modern computational tools for quantitatively measurement of behavior from videos. We will focus on behaviors that are defined by the movements of body-parts (although behavior can be auditory and olfactory). For that, tracking precise movements of body-parts in a sub-second resolution is critical, and you will learn to do so using deep learning tools. Specifically, you will learn to formulate a behavior-related question into a scientific hypothesis; testing it by using computer vision, artificial intelligence, clustering methods and statistical analyses in Python and/or R; and presenting your work, and writing a final report.

APPLICATIONS

Measuring temporal sequences of body postures of wild, domestic, lab animals and humans is crucial for several other fields of research like neurobiology, ecology, biomechanics, biophysics, biomimetics (animal-inspired robots), and medical studies. Such data can also revolutionize performing/visual art forms like dance, acting, and 3D movie creation. Therefore, students from non-biology backgrounds can also benefit from this course. Overall, students will acquire skills of using the latest computational tools to understand animal behavior from a classical viewpoint, as well as to apply these skills and understandings to solve modern day real-world problems.

REQUIREMENTS

A computer (Mac/Windows/Linux) with a minimum of 4 GB RAM and 1.2 GHz processor, internet connection, a Google account, videos of animals or yourself, siblings/ friends/ any other human with properly communicated consent (and NOT sneaking into someone's privacy). We will assume that students have no or little programming skills.
Expected time engagement: 6-8 hours/week.

SUGGESTED PROJECTS

We encourage you to come up with your own questions. However, here are some project ideas from which you can have some ideas.

Project 1: Extract and predict behavior from videos

Pick one animal group, get ~ 50 videos (of ~ 200 minutes), extract posture from the videos, determine the number of behaviors you can get using the artificial intelligence tools, predict behavior from novel videos.

Project 2: Track learning curve

Pick up a learning training task for your pet, or a new dance move for yourself. Track the improvement of the learning using movement data. Additionally, for the pets, you can track its facial expression after a success (may come with a reward) or failure. For the dance project, record all of practice videos and the final performance and compare it with the template video. Similar projects can be done with sport moves as well.

Project 3: Predicting dance form from a novel video

Get videos on different traditional dance forms from the internet, make a model to identify different dance forms. For example, different Indian classical forms vs. Russian vs. other European vs. African vs. any traditional/indigenous dance form.

Project 4: Detect human emotions from facial expressions

From human facial expressions, detect human emotions like smile, laughter, psychological pressure, and sadness. For that, watch a short movie alone, and record yourself. Repeat it with at least 10 people. Use the computational tools to find and count different emotions you/other volunteers showed during the movie. Try to use this model to detect the mental state of a person from a novel video.

"OUR ORGAN OF THOUGHT MAY BE SUPERIOR, AND WE MAY PLAY IT BETTER, BUT IT IS SURELY VAIN TO BELIEVE THAT OTHER POSSESSORS OF SIMILAR INSTRUMENTS LEAVE THEM QUITE UNTOUCHED."
- STEPHEN WALKER