Cognitive and Computational Exploration of Beetle Morphological Diversity

Beetles exhibit a remarkable range of shapes, sizes, colors, and functional features, making them one of the most diverse groups in the animal kingdom. Their morphological diversity not only positions them as a focal point in biological studies but also as a lens to understand human cognitive processes, especially in visual perception and categorization. This project aims to delve into how humans perceive and categorize beetles. By comparing human categorization with computational models, I intend to identify the key features that influence human perception and assess if computational methods can mirror these insights. Given the complexity of visual data beetles present, they serve as an ideal dataset to investigate cognitive processes like pattern recognition. I want to explore what characteristics people focus on when grouping such delightful little bugs.

Methodology and Expected Results

- *Web-based Categorization Task:* Develop a user-friendly web page showcasing a diverse array of beetle images. Participants will be prompted to group these beetles according to their own perceptions of similarity, without any predefined categorization criteria (Fig. 1)
- *Data Analysis:* Analyze the collected data to discern patterns in human categorization. This will provide insights into which morphological features are most salient to human perception.
- *Computational Modeling:* Based on the patterns observed in human categorization, construct a computational model that attempts to replicate human grouping behaviors. This model will serve as a testbed to understand the alignment and discrepancies between human cognition and algorithmic categorization.
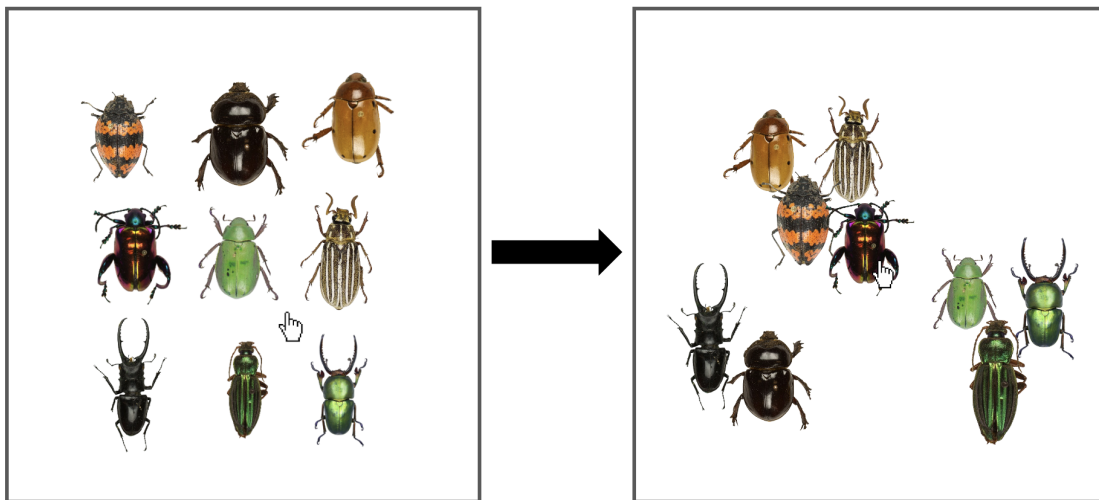

Fig. 1: Beetles before and after users cluster them

I am interested in this topic because my research primarily focuses on community detection and clustering within graphs and networks. Exploring how humans group items will provide valuable insights into my work. Additionally, I really love and have a genuine fascination for beetles.

References

- Xu, F., & Tenenbaum, J. B. (2007). Word learning as Bayesian inference. Psychological review, 114(2), 245–272. https://doi.org/10.1037/0033-295X.114.2.245
- Palmeri, T. J., & Gauthier, I. (2004). Visual object understanding. Nature Reviews Neuroscience, 5(4), 291–303. https://doi.org/10.1038/nrn1364
- Bouchard, P. (2014). The Book of Beetles. Entomopraxis. https://entomopraxis.com/tienda/img/cms/BOUCHARD.pdf