Caleb Charpentier

PhD Student · Biological Sciences

Virginia Tech, 926 W Campus Dr, Blacksburg, VA 24060

+1 225-313-7982 | calebc22@vt.edu | @CalCharp

Education

Virginia Tech — *Blacksburg, VA*

PhD Student - Ecology and Evolutionary Biology — *Auguest 2022 - present*

- Advisor: Dr. Josef Uyeda

Southeastern Louisiana University — *Hammond, LA*

B.S. in Biological Sciences | Minor in Computer Science — *August 2018 - May 2022*

- Undergraduate Mentor: Dr. April Wright

Professional & Research Experience

2020	**Undergraduate Research Volunteer**, O'Mara Lab, Department of Biological Sciences, Southeastern Louisiana University
2019-2022	**Undergraduate Research Assistant**, Wright Lab, Department of Biological Sciences, Southeastern Louisiana University
2020-2022	**Undergraduate Research Assistant**, Schwartz Lab, Department of Biological Sciences, The University of Rhode Island
2023	**Graduate Research Assistant**, Uyeda Lab, Department of Biological Sciences, Virginia Tech

Publications

Published

Mridul Khurana, Arka Daw, M. Maruf, Josef C. Uyeda, Wasila Dahdul, **Caleb Charpentier**, Yasin Bakış, Henry L. Bart Jr., Paula M. Mabee, Hilmar Lapp, James P. Balhoff, Wei-Lun Chao, Charles Stewart, Tanya Berger-Wolf, Anuj Karpatne. 2024. "Hierarchical Conditioning of Diffusion Models Using Tree-of-Life for Studying Species Evolution". ECCV 2024. https://doi.org/10.48550/arXiv.2408.00160

Porto, D. S., Tarasov, S., **Charpentier, C.**, Lapp, H., Balhoff, J. P., Vision, T. J., Dahdul, W. M., Mabee, P. M., & Uyeda, J. (2023). "rphenoscate: An R package for semantics-aware evolutionary analyses of anatomical traits". Methods in Ecology and Evolution, 14, 2531–2540. https://doi.org/10.1111/2041-210X.14210

Mohannad Elhamod, Mridul Khurana, Harish Babu Manogaran, Josef Uyeda, Meghan Balk, Wasila Dahdul, Yasin Bakis, Henry Bart, Paula Mabee, Hilmar Lapp, James Balhoff, **Caleb Charpentier**, David Carlyn, Wei-Lun Chao, Charles Stewart, Daniel Rubenstein, Tanya Berger-Wolf, and Anuj Karpatne. 2023. "Discovering Novel Biological Traits from Images using Phylogeny-guided Neural Networks". 29th SIGKDD Conference on Knowledge Discovery and Data Mining. https://doi.org/10.48550/arXiv.2306.03228

Caleb Charpentier, April Wright. 2022. "Revticulate: An R framework for interaction with RevBayes". *Methods in Ecology and Evolution*, https://doi.org/10.1111/2041-210X.13852

In Preprint or Revision

Harish Babu Manogaran, M. Maruf, Arka Daw, Kazi Sajeed Mehrab, **Caleb Patrick Charpentier**, Josef Uyeda, Wasila M Dahdul, Matthew J Thompson, Elizabeth G Campolongo, Kaiya L Provost, Paula Mabee, Hilmar Lapp, Anuj Karpatne. 2024. "What Do You See in Common? Learning Hierarchical Prototypes over Tree-of-Life to Discover Evolutionary Traits". In review for NeurIPS 2024.

In Preparation

Caleb Charpentier, Josef C. Uyeda. "A Guide for Automated Character Construction in Phenomics and Imageomics".

Caleb Charpentier, Mason Linscott, John Bradley, Matthew Thompson, Arthor Porto, Murat Maga, Josef C. Uyeda. "TraitBlender: An Open Pipeline to Generate Raw Images of Simulated Evolutionary Histories".

Awards, Fellowships, & Grants

2022-Present	**NSF GRFP Fellowship**, National Science Foundation
2021-2022	**Hammond Garden Club Scholarship**, Hammond Garden Club
2019-2020	**Hammond Garden Club Scholarship**, Hammond Garden Club
2018	**Burger King McLAMOR Scholarship**, The Burger King Foundation
	AT&T First Generation Scholarship, The AT&T Foundation
	30+ Priority Scholarship, Southeastern Louisiana University
	TOPS Honors Award, Southeastern Louisiana University

Presentations

Charpentier, Caleb; Uyeda, Josef. 2024. *Can machines think (like biologists)? The promises and pitfalls of AI for accelerated phenotypic discovery from images*. Evolution 2024 - Generative AI as a Powerful New Tool for Studying Evolutionary Biology Symposium. Montreal, Quebec, Canada.

Josef Uyeda & **Caleb Charpentier**. 2024. *Accelerating discovery in biodiversity science and systematics with knowledge-guided machine learning*. Knowledge-Guided Machine Learning Conference. Minneapolis, Minnesota.

Charpentier, Caleb; Linscott, Mason; Uyeda, Josef. 2024. *Simulating the Evolution of 3D Forms for Automated Character Construction*. 2024 Virginia Tech Department of Biological Sciences Research Day. Blacksburg, Virginia.

Charpentier, Caleb; Bradley, John; Linscott, Mason; Maga, Murat; Porto, Arthur; Thompson, Matthew; Uyeda, Josef. 2023. *TraitBlender: An Open Pipeline for Simulating Biological Image Data*. 2023 NSF HDR Ecosystem Conference. Denver, Colorado.

Charpentier, Caleb, Uyeda, Josef. 2023. *Automated Character Construction with Knowledge-Guided Deep Learning*. Evolution 2023. Albuqurque, New Mexico.

Charpentier, Caleb, Wright, April. 2021. *Revticulate: An R framework for Bayesian Phylogenetics*. SouthEast Regional IDeA Conference. San Juan, Puerto Rico.

Charpentier, Caleb, Wright, April. 2021. *RevR: An Integration of Bayesian Phylogenetics with the R Programming Environment*. Louisiana Biomedical Research Network 19th Annual Meeting. Virtual.

Teaching Experience

2020	**Calculus and Algebra Tutor**, Center for Student Excellence, Southeastern Louisiana University
2021-2022	**High School Mathematics Tutor**, Varsity Tutors, Online
2021-Present	**Python & R Programming Tutor**, Wyzant, Online
Fall 2022	**Principles of Biology Laboratory (BIOL_1115)**, Graduate Teaching Assistant

Outreach & Professional Development

Service and Outreach

2019	**Ruaha Carnivore Project Kids for Cats Program**, Outreach Volunteer, Southeastern Louisiana University Lab School
2019	**Math Science Upward Bound**, Teaching Assistant, Southeastern Louisiana University

Development

Biogeography R Workshop - This workshop acted as a think tank for using R to address questions in biogeography. Here, I contributed code and used my Revticulate package to do a joint FDB-DEC analysis to determine the phylogeny of Dicynodonts (a group of non-mammal therapsids). December 11-16, 2023.

2023 NSF HDR Ecosystem Conference - This was a meeting of the different institutes of NSF's Harnessing the Data Revolution Ecosystem. We discussed how artificial neural networks are increasingly being used for automated scientific discovery, and how machine learning can better be adopted into our respective fields, including issues surrounding the interpretability, scalability, and reproducibilty of it in our research. I additionally presented a poster with my TraitBlender pipeline, a tool that can be used for assessing the assumptions made when using deep learning for automated character construction. October 16-18, 2023.

Evolutionary Biology Graduate Student Workshop - This was a week-long workshop at Mountain Lake Biological Station where we worked on out NSF-style grant writing skills and on framing our research questions in relation to big, open problems in ecology and evolutionary research. July 29 - August 5, 2023.

Image Datapalooza 2023 - This was a 3.5 day hackathon-style workshop where we developed new biological datasets for computer-vision competitions with the Imageomics Institute. Foundational progress was made on the TraitBlender pipeline for simulating images of imagined organisms under predetermined evo-devo processes. August 14-17, 2023.

NSF Workshop on High-Dimensional Data Visualization - The workshop was a meeting of domain scientists and data visualization experts to help better understand how domain scientists actually use and visualize dimensional reduction methods in their work. We had useful discussions about the theoretical implications of using dimensionality reduction for knowledge discovery versus knowledge compression, and a paper is currently being written from the discussions. June 13-15, 2023.

Imageomics All-Hands Meeting - This meeting was about discussing the current projects associated with the Imageomics Institute and how the institute as a whole can move forward. This meeting helped me to better understand some of the communication problems that were happening between the biologists and computer scientists in the institute, and helped to guide my research interests for my dissertation. March 21 - 24, 2023.

Phenoscape TraitFest - This workshop was about using computer vision technologies and biological ontology software, such as the Phenoscape Knowledgebase, the better understand traits. During the workshop, I developed a small pipeline to rapidly annotate landmarks from images of mammal teeth: (https://github.com/calcharp/TraitFest_mlmorph). Jan 23-26, 2023.

Software

TraitBlender - A pipeline for generating museum-specimen style images of imagined organisms that evolve under chosen evolutionary/developmental processes
(https://github.com/calcharp/TraitBlender)

rphenoscate - An R package for semantic-aware evolutionary analyses of anatomical traits
(https://github.com/uyedaj/rphenoscate)

Revticulate – A package for interacting with the Rev language via R (https://github.com/revbayes/Revticulate)

SISRS - A Python-based pipeline for identifying phylogenetically informative sites from next-generation whole-genome sequencing of multiple species (https://github.com/SchwartzLabURI/SISRS)

Professional Memberships

The Society for the Study of Evolution