Wilka Torrico De Carvalho, *Aspiring Brain Scientist*

Contact Information

Website: wcarvalho.github.io
Github: github.com/wcarvalho
E-mail: wcarvalh@umich.edu
Google Scholar

Research Interests

I like to think about what "fundamental" models and algorithms the brain may employ to solve the "elementary" parts of the problems it faces. For example, how do we learn to recognize objects, how do we estimate the value of our actions, how do we reason about cause-and-effect? For inspiration on solutions, I seek to draw from machine learning. For example, generative models offer solutions for how brains may learn patterns that describe data production, and reinforcement learning offers solutions for how an agent can choose actions that maximize its satisfaction in the world. Drawn towards social issues, I also intend to explore the conditions under which social stereotyping *naturally emerges* as brains learn to create and generalize category representations for objects.

Topics

Machine Learning: Implicit Inference, Bayesian Nonparametric Methods, Generative Models
Reinforcement Learning: Value Estimation, Credit Assignment, Intrinsic Motivation
Computational Cognitive Science: Stereotyping, Causality, Compositionality
Theoretical Neuroscience: Neural Networks, Sub-symbolic & Distributed Representations

Education

University of Michigan–Ann Arbor, Ann Arbor, Michigan USA
School of Engineering, Ph.D. in Computer Science & Engineering, May 2022

University of Southern California, Los Angeles, California USA
Viterbi School of Engineering, M.S. in Computer Science, May 2017
Advisor: Yan Liu

Stony Brook University, Stony Brook, New York USA
College of Arts and Sciences, B.S. in Physics, May 2015
Advisor: Axel Drees

Brooklyn Technical High School, Brooklyn, New York USA
Diploma in Applied Physics, May 2011

Honors & Awards

1/200 chosen internationally for Heidelberg Laureate Forum	2018
GEM Fellowship sponsored by IBM, Adobe (declined×2)	2017, 2018
University of Michigan Rackham Merit Fellowship	2017
ICLR Travel Award	2017
NSF Graduate Research Fellowship (Neuroscience)	2015
Provost Award for Academic Excellence ($\sim$ 0.5% of graduates chosen)	2015
Researcher of the Month	2014
HHMI Minority Undergraduate Research Fellowship	2014
NSF Louis Stokes Alliance for Minority Participation Scholar	2011
Deans List	2011-2015
USA National Achievement Scholarship Finalist (top 5% nationally)	2011

Preprints

Bryant Chen*, **Wilka Carvalho***, Benjamin Edwards, Taesung Lee, Ian Molloy, Heiko Ludwig, Jaehoon Safavi. *"Detecting Backdoor Attacks on Deep Neural Networks by Activation Clustering."* 2018

Conference Publications

Sanjay Purushotham*, **Wilka Carvalho***, Tanachat Nilanon, Yan Liu. *"Variational Recurrent Adversarial Domain Adaptation."* In 5th International Conference on Learning Representations (ICLR), 2017

Sanjay Purushotham*, **Wilka Carvalho***, Yan Liu. *"Variational Adversarial Deep Domain Adaptation for Health Care Time Series Analysis."* In 29th Annual Conference on Neural Information Processing Systems Workshop on Machine Learning for Healthcare (NIPS ML4HC), 2016 **(Spotlight)**

Wilka Carvalho. *"Modeling a Detection of internally reflected Cherenkov light (DIRC) Particle Detector for High-Multiplicity Collisions."* In State University of New York Undergraduate Research Conference (SURC), 2015

Invited Talks

Machine Learning Lunch Seminar. University of Southern California. (April, 2017)

Symposium Presentations

"Variational Adversarial Deep Domain Adaptation for Healthcare Time Series." *Southern California Machine Learning Symposium. California Institute of Technology*, Pasadena, CA, 2016. **Runnerup, Best Poster. Worth $1000 in Amazon AWS credit.**

"Modeling a DIRC Particle Detector for High-Multiplicity Collisions." *23rd Annual CSTEP Statewide Student Conference*, Bolton Landing, NY, 2015. **2nd Place, Physics and Math.**

"Modeling the Cognitive Process of Attributing Traits to Others." *Summer Seminar Day. California Institute of Technology*, Pasadena, CA, 2014.

"Modeling Deep Brain Stimulation of Globus Palidus Internus." *22nd Annual CSTEP Statewide Student Conference*, Bolton Landing, NY, 2014.

"Modeling a Detection of internally reflected Cherenkov light (DIRC) Particle Detector for High-Multiplicity Collisions." *URECA Celebration of Undergraduate Research & Creativity. Stony Brook University*, Stony Brook, NY, 2014.

"Modeling Deep Brain Stimulation of Globus Palidus Internus." *Poster Symposium. University of Minnesota*, Minneapolis, MN, 2013.

Research Experience

Microsoft, Redmond, Washington USA
Microsoft Research, *June 2018 – August 2018*
Advisor: Sumit Basu

IBM Almaden, San Jose, California USA
IBM Research, *September 2017 – December 2017*
Advisor: Heiko Ludwig

- Contributed to novel research algorithm by suggesting subspace projection technique that increased our performance from 15% to 95% accuracy. Designed and implemented environment for testing algorithm.
- Developed baseline and state-of-the-art neural networks using Tensorflow.
- Built data pipeline for large image dataset.

Visa, Palo Alto, California USA
Visa Research, *June 2017 – August 2017*
Advisor: Hao Yang

- Formulated a novel neural network for learning a language model.
- Implemented model and baselines for language generation and question answering using Tensorflow and Facebook's ParlAI NLP software.
- Performed extensive literature reviews on machine reading comprehension and generative models.

University of Southern California, Los Angeles, California USA
Melady Machine Learning Lab, *November 2015 – May 2017*
Advisor: Yan Liu
Samsung and NSF funded project: "Variational Adversarial Deep Domain Adaptation for Health Care Time Series Analysis"

- Implemented novel neural network that employed variational inference and adversarial training for transfer learning of multivariate time-series.
- Proposed analyses used in publications to empirically verify that our model (a) performed domain adaptation by creating domain-invariant representations and (b) transferred temporal dependencies across domains. Research led to 2 publications and a patent.
- Communicated research to general public through research feature by the USC Graduate School and to technical audience at ICLR poster presentation.

Stony Brook Univeristy, Stony Brook, New York USA
Heavy Ion Research Group, *January 2013 – August 2015*
Advisor: Axel Drees
DOE funded project: "Modeling a Detection of internally reflected Cherenkov light Particle Detector for High-Multiplicity Collisions"

- Built and maintained a simulator in C++ for the heavy ion particle detector at the Brookhaven National Laboratory.
- Contributed methods from multivariate calculus and linear algebra to particle detection algorithm. Accuracy improved from 60% to 80%.
- Designed and implemented a statistical analysis pipeline in C++ for measuring efficacy of particle detection algorithm.

Stony Brook Univeristy, Stony Brook, New York USA
Computational Neuroscience Group, *Fall 2014*
Advisor: Giancarlo La Camera
NSF LSAMP funded project: "Spectral Analysis of Rodent Neural Data"

- Performed spectral analyses on neural data to determine behavioral correlates of neural activity.

California Institute of Technology, Pasadena, California USA
Emotion and Social Cognition Laboratory, *Summer 2014*
Advisor: Ralph Adolphs
HHMI funded project: "Modeling the Cognitive Process of Attributing Traits to Others"

- Formulated a trait learning behavioral experiment to study human inference.
- Built online platform to administer psychology experiments using Javascript, PHP, and HTML.

University of Minnesota, Minneapolis, Minnesota USA
Neuromodulation Research and Technology Laboratory, *Summer 2013*
Advisor: Matthew Johnson
NIH funded project: "Modeling Deep Brain Stimulation of Globus Palidus Internus"

- Implemented python script to build a biologically feasible computational model of neural networks
- Created template for using python to simulate deep brain stimulation with "Neuron" software

National Central University, Jhongli City, Taiwan
Turbulent Combustion Laboratory, *Summer 2012*
Advisor: Shenqyang Shy
"Empricial Analysis of Theories from Fluid Dynamics"

- Explored boundary layer conditions, and laminar and turbulent flow of fluids through pipes of varying cross-sections.

Teaching Experience

Stony Brook University, Stony Brook, NY
Calculus Instructor, *Spring 2015*
Worked with two math professors to develop and teach a supplementary calculus curriculum that promoted minority representation in stem majors.

Stony Brook University, Stony Brook, NY
Educational Opportunity Program Personal Tutor, *Spring 2013 - Fall 2014*
Tutored marginalized students in introductory physics and math courses

Service

Student Volunteer, ICLR, 2017

Outreach

Research and Fellowships Week NSF Panel, Los Angeles, CA, 2016
National Society of Black Engineers Grad Panel, Los Angeles, CA, 2016
Graduate School External Fellowship Boot Camp, Los Angeles, CA, 2016
Mentored marginalized high school youth through the Pullias Center for Higher Education, Los Angeles, CA, 2016
Engineering Graduate Diversity Symposium, Los Angeles, CA, 2015
Black Student Association: What it takes to go to Graduate School, Los Angeles, CA, 2015
Collegiate Science and Technology Entry Program Undergraduate Research Panel, Stony Brook, CA, 2014

Skills

Machine Learning Software: TensorFlow, Theano, Pytorch, Keras
Neuroscience Software: Neuron
Languages: Python, C++, C, Java
Systems: Unix, Linux, OSX

Press

Black History Month: Why a career in science?
Research Feature by the USC Graduate School
2015 NSF Graduate Research Fellow Wilka Carvalho
Biomath Learning Center Launches Modified Supplemental Instruction Program
URECA Research of the Month: Wilka Carvalho
Student Feature by Stony Brook University

Interests

• traveling • chess • software development • improvisational dance • deadpan humor