Jimmy Hyun Jin Kim

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Education

Northwestern University, Evanston, IL. 2015-2020 (expected)
Ph.D. Candidate, Physics. (Advisor: David J. Schwab)
CGPA: 3.928

University of Toronto, Toronto, ON. 2011-2015
Honours B.Sc. with High Distinction, Mathematics and Physics Specialist.
CGPA: 3.97

IDEAS Traineeship at Northwestern University	2017-present
RSG Research Communication Program at Northwestern University	2017
Cargese Summer School on Theoretical Biophysics	2017
Ontario Summer School on High Performance Computing	2015

Certificates

Neural Networks for Machine Learning (Coursera)	2017
Computational Neuroscience (Coursera)	2017
Integrated Data Science (Northwestern University)	2017
Machine Learning (Coursera)	2016
High Performance Computing (SciNet)	2015
Scientific Computing (SciNet)	2015

Honors and Awards

The Hymie and Roslyn Mida Student Award in Theoretical Physics	2015
Trinity College Provost's Scholar	2015
NSERC Undergraduate Student Research Award	2013,2014
Dean's List Scholar	2012,2013,2014
The Coxeter Scholarship in Mathematics	2013
The William Ramsay Scholarship in Physics	2013
The Harry Boxen Memorial Scholarship in Physics	2013
Chancellor's Scholarship	2012,2013
Dr. John Knowles Colling Memorial Scholarship	2012
Summer Undergraduate Research Fellowship	2012
University of Toronto Scholar	2011
The Wasteneys Admission Scholarship	2011

Experience

Teaching Assistant at Northwestern University (Sep. 2016 - June 2018)

- Led discussion sessions consisting of 10-50 students, held office hours, and graded tests.
- Subjects included classical mechanics, electromagnetism, and special relativity.

Current Projects

Dynamical mean field theory of recurrent networks

- We seek to use mean field theory to study the dynamical properties of recurrent networks, particularly relating to the nature of time updates and the usage of gates.
- Preliminary experiments suggest that continuously updated recurrent networks have higher memory capacity than discrete networks in the context of reservoir computing.

Nonlinear dynamics of multi-agent reinforcement learning

- We built a platform for multi-agent reinforcement learning using TensorFlow.
- We will use nonlinear physics to characterize the dynamics of multi-agent reinforcement learning and inform the appropriate choice of hyperparameters.

Past Projects

Active learning in Natural Language Processing

- We used PyTorch to implement a reinforcement learning inspired framework to facilitate active learning for language modelling.

Continual learning with Elastic Weight Consolidation

- We used PyTorch as well as TensorFlow to implement the EWC algorithm which allows for the learning of multiple tasks in a single neural network by selectively constraining the weight adjustments based on Fisher Information.
- We plan to incorporate this into future research for analyzing the task capacity of a network.

Visualizing neural decoding with head direction cells

- We built an interactive visual demonstration of neural decoding process in head direction cells using HTML, CSS, and JavaScript (D3.js).
- The product has been used as an aid for explaining research results to people outside the field.

Soccer Success: ML for predicting the outcome of soccer matches

- We built a pipeline for predicting the outcome of soccer matches by using in-game stats from the FIFA video game franchise as features for machine learning.
- Weka as well as a custom Python script was used to implement machine learning functionalities.
- Submitted as the final project for a machine learning course where it was graded 20.1/20 [sic].

Superlinear precision and memory in neural coding

- We analytically derived optimal scaling relations in sensory and memory networks and developed simulations in both Python and MATLAB to numerically confirm the theoretical results.
- We discovered that superlinear scaling of precision is possible in spite of the failure of the Cramer-Rao bound given by the Fisher Information.
- Publication in preparation.

Neuronal tracking and activity measurement in C. elegans

- We developed image processing platform in MATLAB for tracking and quantifying fluorescence intensity (proxy for activity) from multiple neurons in *C. elegans*.
- The platform has been used to discover a previously unknown neural circuitry.
- Results published in eLife.

Volunteering/ Outreach

Judge, High School Project Showcase at Northwestern University	2018
Mentor, Physics Mentorship Program at University of Toronto	2017-2018
Demonstrator, 100 in 1 Day	2014
Demonstrator, Science Rendezvous	2012,2014

Publications

Pan-neuronal screening in Caenorhabditis elegans reveals assymetric dynamics of AWC neurons is critical for thermal avoidance behavior.
Authors: I. Kotera, N.A. Tran, D. Fu, **J.H.J. Kim**, J.B. Rodgers, W.S. Ryu
eLife **5**, e19021 (2016)

Talks

"Optimizing population coding and short term memory", APS March Meeting	2018
"Optimal neural coding and short term memory", SIAM Bridging the Gap	2018
"Too much precision can be bad", Seven Minutes of Science	2017

Languages

(fluent) English, Korean, Python, MATLAB, Mathematica
(basic) HTML, CSS, JavaScript, C++, Visual Basic