

# T. Anderson Keller

Machine Learning PhD Candidate

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## Git

akandykeller

## Programming

Python ★★★★★

C/C++ ★★★★★

Matlab ★★★★★

## Packages

PyTorch, Tensorflow,  
JAX, Numpy, SciPy,  
Weights & Biases,  
Pandas, Scikit-learn

## Interests

Comp. Neuroscience  
Statistical Mechanics  
Cognitive Science

## Languages

English ★★★★★

French ★★★★★

## Education

'18 - (Expected) '23 **Ph.D. Machine Learning**

University of Amsterdam

Supervisor: Professor Max Welling

Thesis: Structured Representation Learning with Probabilistic Generative Models

'15 - '17 **M.S. Computer Science**

University of California San Diego

Supervisor: Professor Garrison Cottrell

Thesis: Comparison and Fine-grained Analysis of Sequence Encoders for NLP

'11 - '15 **B.S. Computer Science (Honors)**

California Institute of Technology

Related Coursework: Machine Learning, GPU Programming (CUDA), Stochastic Modeling

## Experience

Jun. '22 - Oct. '22 **Research Science Intern**

Apple

- Developed "Homomorphic Self-Supervised Learning", a framework which subsumes data augmentation in self-supervised learning through structured equivariant representations.

Jun. '16 - Sept. '18 **Deep Learning Data Scientist**

Intel Nervana

- Researched symbol-binding in RNNs with fast-weight associative memory.
- Developed few-shot object localization models for live recognition and tracking of race cars.

Summer '15 **Data Science for Social Good Fellow**

University of Chicago

- Built model to determine the influences of home abandonment in Mexico.
- Presented at KDD 2016 Applied Data Science Track. Project: <https://goo.gl/touSWT>

## Selected Publications

**Topographic Coupled Oscillator Networks Learn Transformations as Traveling Waves**

T. Anderson Keller & Max Welling. Nov. 2022.

Under Review

<<https://akandykeller.github.io/papers/Waves.pdf>>

**Homomorphic Self-Supervised Learning** Under Review & SSL Workshop @ NeurIPS 2022

T. Anderson Keller, Xavier Suau & Luca Zapella. Oct. 2022.

<<https://arxiv.org/abs/2211.08282>>

**Topographic VAEs learn Equivariant Capsules** NeurIPS 2021

T. Anderson Keller & Max Welling. 3 Sept 2021. <<https://arxiv.org/abs/2109.01394>>

**Modeling Category-Selective Cortical Regions with TVAEs** SVRHM @ NeurIPS 2021

T. Anderson Keller\*, Qinghe Gao\* & Max Welling. 25 Oct 2021. (**Best Paper Award**)

<<https://arxiv.org/abs/2110.13911>>

**Predictive Coding with Topographic VAEs** Visual Inductive Priors Workshop ICCV 2021

T. Anderson Keller & Max Welling. 26 Jul 2021. (**Oral**)

<<https://openreview.net/pdf?id=WvUOFEEsncx>>

**Self Normalizing Flows** ICML 2021 & Beyond Backpropagation Workshop @ NeurIPS 2020

T. Anderson Keller, Jorn W.T. Peters, Priyank Jaini, Emiel Hoogetboom, Patrick Forré, Max

Welling. 14 Nov 2020. <<https://arxiv.org/abs/2011.07248>>

## Publications

### Locally Coupled Oscillatory Recurrent Neural Networks Learn to Exhibit Traveling Waves and Topographic Organization Under Review

T. Anderson Keller & Max Welling. Dec. 2022.

<<https://akandykeller.github.io/papers/LoCoRNN.pdf>>

### As easy as APC Workshop on Self Supervised Learning @ NeurIPS 2021

Fiorella Wever, T. Anderson Keller, Victor Garcia, Laura Symul. 29 Jun 2021.

<<https://arxiv.org/abs/2106.15577>>

### Fast Weight Long Short-Term Memory ArXiv Preprint 2018

T. Anderson Keller, S. Sridhar, X. Wang. Fast Weight Long Short-Term Memory. 18 Apr

2018. <<https://arxiv.org/abs/1804.06511>>

### Designing Policy Recommendations to Reduce Home Abandonment in Mexico KDD '16

K. Ackermann, E. Reyes, S. He, T. Anderson Keller, P. van der Boor, R. Kahn. *Proceedings of the 22nd ACM SIGKDD International Conference on Knowledge Discovery and Data Mining*. 13 Aug 2016. (Oral)

<<http://www.kdd.org/kdd2016/papers/files/adf0913-ackermannA.pdf>>

### Experimental Realization of a Nonlinear Acoustic Lens with a Tunable Focus APL '14

C. Donahue, P. Anzel, L. Bonanomi, T. Anderson Keller, C. Daraio. *Appl. Phys. Lett.*. 9 Jan

2014. <<https://arxiv.org/abs/1308.1483>>

## Invited Talks

05 Jan '23	Kanwisher Lab	Massachusetts Institute of Technology
11 Nov '22	Geometric Deep Learning Reading Group ( <a href="#">link</a> )	University of Amsterdam
03 Mar '22	Seminar on Advances in Probabilistic Machine Learning	Aalto University
19 Nov '21	Debora Marks Lab, Journal Club	Harvard Med. (Online)
12 Oct '21	Intel Labs, Deep Learning CoP	Santa Clara, CA (Online)

## Master's Thesis Supervision

### '21 Modeling the Emergence of Face Selective Cortical Regions Qinghe Gao

Employing generative models combined with novel topographic priors to study the emergence of domain-selective cortical regions (such as the Fusiform Face Area) in modern deep neural networks. Comparison with macaque data shows strong similarities.

<<https://arxiv.org/abs/2110.13911>>

### '20 As Easy as APC Fiorella Wever

Researching Autoregressive Predictive Coding (APC) as a self-supervised representation learning solution to handle datasets with high levels of missing data and class imbalance simultaneously – demonstrated benefits over existing data imputation and class imbalance methods on a synthetic dataset, achieved SoTA AUPRC on Physionet 2012 medical dataset.

<<https://arxiv.org/abs/2106.15577>>

### '20 Spatio-Temporal Forecasting On Graphs w/ Incomplete Data Noah van Grinsven

Combining graph neural networks with data imputation for spatio-temporal forecasting.

<<https://scripties.uba.uva.nl/search?id=719556>>

### '19 Geometric Priors for Disentangling Representations Samarth Bhargav

Researching the use of non-euclidean priors as a supervisory signal for disentangled representation learning of topologically equivalent generative factors.

<<http://scriptiesonline.uba.uva.nl/document/676481>>

## Teaching Assistant Positions

- Winter '20 **Leren (Bachelor's Machine Learning)** University of Amsterdam  
Designed practice problems for matrix derivatives and PCA.
- Winter '19 **Machine Learning 2 (Master's)** University of Amsterdam  
Ran practical labs including implementations of ICA, message passing, EM & VAEs.
- Winter '16 **Data Visualization** University of California, San Diego  
Designed homework assignments, demos, and class tutorials for D3.js & Bokeh.

## Selected Projects

- Summer '22 **Traveling Waves in Deep Generative Models** University of Amsterdam
- Developed a recurrent generative model biased towards latent codes with complex spatio-temporal synchrony. Demonstrated the model learned to use traveling waves as a mechanism to efficiently represent observed physics dynamics.
  - Videos of Waves & Dynamics: <https://github.com/q2w4/LocoRNN>
- Summer '21 **Topographic Variational Autoencoders** University of Amsterdam
- Developed a method for training deep generative models with topographically organized latent variables, yielding a nonlinear version of Topographic ICA. Demonstrated how topographic organization could be leveraged to learn approximate equivariance to sequence transformations without supervision.
  - Git: <https://github.com/akandykeller/TopographicVAE>
  - Video: <https://www.youtube.com/watch?v=8QJm06u0SwM>
  - Media Coverage: <https://www.youtube.com/watch?v=pBau7umFhjQ>
- Fall '20 **Self Normalizing Flows** University of Amsterdam
- Derived a novel method for training unconstrained normalizing flow architectures using learned approximate gradients. Demonstrated significantly faster training while reaching the same likelihood as the corresponding exact gradient.
  - Video: <https://www.youtube.com/watch?v=6Q3b3MergqI>
  - Blog: <http://keller.org/research/2020-10-21-self-normalizing-flows/>
- Summer '17 - Summer '18 **Ferrari Challenge Tracking and Classification** Intel AI Lab
- Closely collaborated with diverse teams across Intel to deliver live-inference pipeline for tracking and fine-grained classification of race cars from few labeled examples.
  - Keynote: [https://youtu.be/pSZn\\_bYA1k?t=3990](https://youtu.be/pSZn_bYA1k?t=3990)
  - Blog: <https://goo.gl/PmQss8>
  - TWiML Podcast: <https://goo.gl/6NeMnp>
- Winter '17 **Fast Weight Long Short-Term Memory** Intel AI Lab / Personal
- Developed and experimented with multiple novel Fast-Weight LSTM architectures to characterize synergistic effects between gated RNNs and fast weight associative memory. Showed faster learning and increased accuracy on associative recall tasks. Showed near equivalence with Memory Network attention mechanism on bAbI QA tasks.
  - Git: [https://github.com/akandykeller/fast\\_weights](https://github.com/akandykeller/fast_weights)
- Fall '16 - Spring '17 **Analysis of Sequence Encoders for NLP** Master's Thesis
- Developed Variational Skip-Thought framework for learning sentence representations.
  - Git: <https://github.com/akandykeller/skip-thoughts>