

Derek Onken

Philomath, Polymath, BS in Math

<https://derekonken.com/>

W302 Math & Science, Emory University | donken@emory.edu

CURRENT RESEARCH INTERESTS

I value the mathematical, computer science, and statistical theory used to develop models; I enjoy applying the theory to practical applications, especially problems with biological motivation.

PDE-based Machine Learning

- Applying partial differential equation (PDE) knowledge to neural networks, specifically higher-order time integration schemes and the Discretize-Optimize approach.
- Using PDE-based neural networks to lower false positives in lung cancer diagnosis
- Developing methods to efficiently train high-dimensional continuous normalizing flows
- Solving high-dimensional optimal control problems

EDUCATION

Ph.D. in Computer Science, Emory University

expected 2021

M.S. in Computer Science, Emory University

2019

Advisor: Lars Ruthotto

Research: Discretize-Optimize Neural Ordinary Differential Equations and Optimal Approaches to Continuous Normalizing Flows

B.S. in Mathematics and Computer Science, Honors College, University of Georgia

2015

Minors: Physics and Classical Culture

Honors: Graduated High Honors with Capstone

Advisor: Juan Gutierrez

Research: Statistical analysis of natality data and the relationships of sex ratio against gestation length and calendar distribution

COMPUTATIONAL SKILLS

- *Comfortable in* PYTHON, PYTORCH, MATLAB, SQL, JAVA
- *Familiar with* Julia, TENSORFLOW, KERAS, C, C++, R, x86, MPI

WORK EXPERIENCE

Data Scientist Intern, *UnitedHealth Group, R&D*

Jun-Aug 2019, May-Aug 2020

- Designed and led lung cancer initiative
- Developed medical image data pipeline, a model for the company's future imaging projects
- Implemented PDE-based neural network for image classification of 3-D low-dose computed tomography (LDCT) images to assist in lowering false positives of cancer diagnosis

High Performance Computing Intern, *Air Force Research Labs, UES Inc.*

May-Aug 2018

- Implemented convolutional neural network to perform cell segmentation as part of a toxicological bioanalytic pipeline
- Extended pipeline's capabilities for handling clumping cells, reducing its dependence on time-consuming human annotation

Teaching Assistant, *Emory University*

Aug 2016-May 2018

- Assisted instructor through grading, holding office hours, occasional lecturing, and lab design for undergraduate courses in Introductory Java, Numerical Analysis, and Data Mining

Tutor, *UGA Athletic Department*

Jan-May 2016

- Instructed Multivariable Calculus, Differential Equations, Discrete Math, Systems Programming, and Introductory Java

Undergraduate Researcher, *UGA Mathematics Department*

May-Aug 2014

- Implemented parallelizations methods MPI, OpenCL, and CUDA for comparison on a PDE

- Application to Gene Set Enrichment Analysis (GSEA) studying malaria in primate host: after code optimization and parallelization, runtime improved from 1 week to 15 seconds using 100 cores

Piano Teacher

Aug 2013-Mar 2014

- Instructed an 8-year old and 10-year old weekly

Summer League Swim Coach

Apr-Jun 2009, Apr-Jun 2010

- Coached and taught children between ages 5 and 18

LEADERSHIP & SERVICE**External Reviewer** for Mathematical Sciences of Machine Learning Conference

2020

Emory Society for Industrial and Applied Mathematics Chapter

Aug 2016-present

- Host “how to” events for graduate students (set-up Emory personal webpage, use L^AT_EX, etc.)
- Volunteer at the annual Atlanta Science Festival

University of Georgia Men’s Swimming & Diving Team

Aug 2011-May 2015

Captain & Division I Varsity Athlete

- Hosted and advised prospective student-athlete recruits
- Competed at the SEC championships
- Qualified and competed at the 2016 U.S. Olympic Trials
- NCAA Academic All-American Honorable Mention 2013, 2014, 2015
- Awarded “Scholar-Athlete” Award for entire Athletic Department 2015
- Awarded Ramsey Scholarship for Academic and Athletic Excellence Aug 2014-May 2015
- Awarded “Hardest Worker” Swimming Award 2014, 2015
- Awarded “Scholar-Athlete” Swimming Award 2014

Student-Athlete Advisory Committee, Team Representative

Aug 2014-2015

- Served as interface between student-athletes and administrative officials
- Organized and participated in Community Service programs (Hunger Bowl, Hometown Heroes, etc.)

HONORS & AWARDS

- Phi Beta Kappa 2015
- UGA Presidential Scholar 2014
- UGA Athletic Director’s Honor Roll 2012-2015
- Southeastern Conference Academic Honor Roll 2012-2015
- UGA Dean’s List 2012-2015
- IBM Thomas J. Watson Memorial Scholarship Recipient 2011-2015
- Chartered Property Casualty Underwriter (CPCU) Scholarship Recipient 2011

PUBLICATIONS

- **D. Onken**, S. W. Fung, X. Li, L. Ruthotto. OT-Flow: Fast and Accurate Continuous Normalizing Flows via Optimal Transport. [preprint](#) [Submitted]
- **D. Onken**, L. Ruthotto. Discretize-Optimize vs. Optimize-Discretize for Time-Series Regression and Continuous Normalizing Flows. [preprint](#) [Submitted]
- Y. Vigfusson*, T. Karlsson*, **D. Onken***, *et al.* Cellphone traces reveal infection-associated behavioral change. [Submitted]

* denotes co-first authors

INVITED TALKS

- **D. Onken**. “Efficient and Accurate Discretize-Optimize Approaches for Training Deep Residual Networks” in *SIAM Mathematics of Data Science 2020*, [link](#).

PEER-REVIEWED POSTER PRESENTATIONS

- **D. Onken**, S. W. Fung, X. Li, L. Ruthotto. “Normalizing Flows Via Mean Field Games and Hamilton-Jacobi-Bellman Equations” in *SIAM/CAIMS AN2020*, [link](#).
- **D. Onken**, R. Jennings, S. Garth, E. Haber, E. Treister, S. Novikov, L. Ruthotto. “Using PDE-Based Neural Networks for Classifying 3-D LDCT Images for Lung Cancer Detection” in *IPAM Deep Learning for Medical Applications 2020*, [link](#).

SELECTED PRESENTATIONS & POSTERS

- Image Classification For Lung Cancer Via Neural Networks Based On Partial Differential Equations, *UnitedHealth Group Intern Presentation*, Aug 2019, talk
- PDE-based Neural Networks, *UnitedHealth Group Brown Bag Lecture Series*, Jul 2019, talk
- Applying Higher-Order Runge-Kutta Methods To Neural Networks, *Emory Scientific Computing Seminar*, Apr 2019, [talk](#)
- Applying Higher-Order Runge-Kutta Methods To Neural Networks, *Georgia Scientific Computing Symposium*, Feb 2019, [poster](#)
- Cell Segmentation via Convolutional Neural Networks, *High Performance Computing and Modernization Program*, Aug 2018, poster and talk
- Tracking Behavioral Alterations via Cell Phone Data, *Amazon Graduate Research Symposium*, Oct 2017, [poster](#)

SELECTED RELEVANT COURSEWORK

Coursework at Emory University:

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|--------------------------|--------------------------|-------------------------------|
| – Numerical Optimization | – Data Mining | – Systems Programming |
| – Deep Learning Numerics | – Machine Learning | – Distributed Processing |
| – Numerical Analysis II | – Biostatistical Methods | – Database Systems |
| – Numerical Analysis I | – Algorithms | – Computer Security (Hacking) |

Graduate-level coursework at the University of Georgia:

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|---------------------|--------------|------------------------|
| – Bivariate Splines | – Automata | – Software Engineering |
| – Complex Analysis | – Algorithms | – Thermodynamics |