

# Max Hirsch

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## Education

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### University of California, Berkeley

Aug 2023 - Present

*Ph.D. in Applied Mathematics*

- National Science Foundation Graduate Research Fellowship
- Advisor: Professor Franziska Weber
- GPA: 4.0/4.0

### Carnegie Mellon University

Aug 2019 – May 2023

M.S. in Mathematical Sciences, B.S. in Mathematical Sciences

- Thesis : An Energy-Stable Finite Element Scheme for the Q-tensor Model of Liquid Crystals Subject to an Electric Field
- Advisor: Professor Franziska Weber
- GPA: 4.0/4.0

### École Polytechnique Fédérale de Lausanne

May 2022 - Jan 2023

*Exchange Semester*

- Semester Project : Continuous Time Stochastic Gradient Descent for Parameter Identification in Multiscale Diffusions
- Advisor: Professor Fabio Nobile
- Grade: 5.95/6.00

## Teaching

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### Research Mentor, University of California, Berkeley

Fall 2023 - Present

- Leon Mikulinsky, Q-Tensor Bayesian Inverse Problem (Summer 2024 - Present)
- Yijin (Cici) Wang, Physics-Informed Neural Networks for Q-Tensors (Summer 2024)
- Jose Luis Alarcon, Discovering Numerical Schemes from Data (Fall 2023)

### Teaching Assistant, Carnegie Mellon University

Fall 2020 - Spring 2023

- Vector Calculus for Computer Scientists, Spring 2023
- Matrices and Linear Transformations, Fall 2021
- Integration and Approximation, Spring 2021
- Matrices and Linear Transformations, Fall 2020

## Publications

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### Journal Articles

**Stochastic gradient descent in continuous time for drift identification in multiscale diffusions**

November 2024

Max Hirsch, Andrea Zanoni

[ESAIM: Mathematical Modelling and Numerical Analysis 58 \(6\), 2387-2414](#) [🔗](#)

### Preprints

**The Zero Inertia Limit for the Q-Tensor Model of Liquid Crystals: Analysis and Numerics**

October 2024

Max Hirsch, Franziska Weber, Yukun Yue

[arXiv preprint arXiv:2410.18328](#) [🔗](#)

**Neural empirical interpolation method for nonlinear model reduction**

June 2024

Max Hirsch, Federico Pichi, Jan Hesthaven

[arXiv preprint arXiv:2406.03562](#) [🔗](#)

# A Convergent Finite Element Scheme for the Q-Tensor Model of Liquid Crystals Subjected to an Electric Field

July 2023

Max Hirsch, Franziska Weber

arXiv preprint [arXiv:2307.11229](https://arxiv.org/abs/2307.11229) 

## Talks

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- Computational Math Seminar at UC Berkeley, *Bayesian Inverse Problem for the Q-Tensor Model of Liquid Crystals* (October 2024)
- Applied PDE Student Seminar at UC Berkeley, *Neural empirical interpolation method for nonlinear model reduction* (August 2024)
- European Congress on Computational Methods in Applied Sciences and Engineering, *Neural empirical interpolation method for nonlinear model reduction* (June 2024)
- EPFL Chair of Computational Mathematics and Simulation Sciences Seminar, *Applications of MLniCS : A Library for Physics-Informed Machine Learning for Parametric Problems* (November 2022)
- Finite Element Circus at Penn State, *Finite Elements for the Q-Tensor Flow of Liquid Crystals* (November 2021)

## Work Experience

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### Research Assistant

Remote

Professor Jay Newby, University of Alberta Department of Mathematical and Statistical Sciences

May 2020 – Aug 2021

- Estimated particle densities in videos using convolutional neural networks, achieving 6% error in estimates of the total number of particles from these densities.
- Used Monte Carlo methods for maximum likelihood estimation of the diffusion constant arising from the master equation describing particle motion.

### Data Science Intern

Hickory, NC

Matrix Retail

May 2019 – Aug 2019



- Created a new scalable sales forecasting algorithm for high-dimensional data which automatically tunes parameters, trains, and forecasts with bootstrapped prediction intervals for over 1000 retail stores to reduce the time of the former forecasting algorithm by 300% without sacrificing accuracy.
- Enabled more efficient evaluation of forecasts by creating a graphical user interface for running the forecasting algorithm and visualizing the resulting forecasts and prediction intervals.

## Projects

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### MLniCS Code Library

May 2022 - January 2022

- Developed MLniCS, a code library for building physics-informed neural networks for reduced order parameterized partial differential equations.
-  [MLniCS Repository](#) 

### Tetris Reinforcement Learning (Project Leader)

Spring 2020 - Fall 2020

- Led a Data Science Club project group in which we trained a reinforcement learning model with the REINFORCE algorithm and Monte Carlo tree search to play Tetris.

### Duke Datafest Rugby Player Health Prediction

April 2019

- Implemented a neural network, random forest, and support vector machine to determine the effect of a workout on Canadian women's rugby players health with over 70% accuracy.

### MathWorks Math Modeling Challenge (1st Place, Technical Computing)

March 2019

- Classified likely high school student drug users based on demographic data with average accuracy of 77% across all drugs in the study. Implemented the Metropolis-Hastings algorithm as part of a model to predict the spread of drug use in high school students.

### Reducing Exam Conflicts with Hill Climbing (Implemented Fall 2019)

February 2019

- Designed a hill climbing algorithm which reduced the number of exam conflicts at the North Carolina

School of Science and Mathematics to half the number of conflicts while maintaining schedule structure. Implemented for the 2019 fall trimester.

## Honors and Awards

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- May 2024 - Conference Travel Grant, UC Berkeley Graduate Division
- April 2023 - Mathematics Prize for outstanding scholastic achievement during undergraduate career, CMU Dept. of Mathematical Sciences
- April 2023 - Nominated to Phi Beta Kappa Society
- March 2023 - National Science Foundation Graduate Research Fellowship
- May 2022 - Richard A. Moore Award for outstanding scholastic achievement, CMU Dept. of Mathematical Sciences
- April 2022 - Grant to attend HYP2022 Conference on Hyperbolic Problems
- March 2022 - ThinkSwiss Research Scholarship
- February 2022 - EPFL Research Internship Scholarship of Excellence
- May 2021 - Richard A. Moore Award for outstanding scholastic achievement, CMU Dept. of Mathematical Sciences
- November 2019 - CMU Data Science Club November Challenge Winner
- May 2019 - CMU Quantitative Social Science Scholar (QSSS)
- March 2019 - MathWorks Math Modeling Challenge (M3C) Honorable Mention, 1st Place in Technical Computing
- February 2019 - Mathematical Contest in Modeling (MCM) Honorable Mention

## Skills

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**Languages:** Python, C, MATLAB, SML, Java, R

**Libraries:** Pandas, Numpy, Scikit Learn, Matplotlib, Numba, PyTorch, TensorFlow

**Tools:** Git, Vim, L<sup>A</sup>T<sub>E</sub>X