

# DEREK HART

derekjordanhart@gmail.com ◇ linkedin.com/in/derekhart0 ◇ github.com/dhart31

303 501 7428 ◇ Atlanta, GA 30308

## TECHNICAL EXPERIENCE

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- Used Python and Bash to acquire, aggregate, analyze, and visualize data from molecular dynamics simulations performed in a remote high-performance computing environment
- Created machine learning models with Scikit-learn and Keras to make predictions from imbalanced, sparsely-populated or high-dimensional datasets
- Long-term experience communicating technical results to a variety of audiences via oral presentations and written publications.
- Developed a microscope interface and data collection platform using C++
- Created a MATLAB toolbox using image and signal processing methods to interpret microscopy data

## EDUCATION

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### Georgia Institute of Technology, Atlanta GA

- Ph.D. in Physics, Minor in Advanced Optics Expected Sep 2022
- M.S. in Physics, GPA: 3.70/4.00 2018
- Award: Georgia Tech Institute Fellowship

### Colorado School of Mines, Golden CO

- B.S. in Engineering Physics, GPA: 3.87/4.00 2016
- Award: Physics Faculty Distinguished Graduate

## SKILLS

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**Programming:** Python (Scikit-Learn, Keras, Seaborn, Matplotlib, Pandas), C++, Bash, R, SQL, LaTeX, Javascript, Octave

**Software:** MATLAB, oxDNA, Linux, Adobe Suite, Visual Studio, RStudio, Microsoft Office suite

## WORK EXPERIENCE

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**Data Scientist** (*professional development*) 2022  
*Predicting wheat phenotypic traits*

- Built a “genotype to phenotype model” for a wheat breeding line dataset using Support Vector Regression
- Efficiently selected optimal hyperparameters using Bayesian search cross-validation

*Predicting house prices*

- Estimated house prices with high accuracy using Random Forest and XGBoost models
- Performed feature analysis and visualization to choose estimator inputs
- Built scikit-learn pipeline to impute and encode categorical inputs

*Predicting diabetes risk*

- Created a diabetes diagnostic test with a neural network model using Keras
- Rebalanced survey data with random oversampling
- Ranked diabetes risk factors using permutation importance

### Graduate Research Assistant

2017 - Present

Kim Lab, School of Physics, Georgia Institute of Technology, Atlanta GA

*Computational project: Coarse-grained DNA modeling*

- Constructed, organized, and performed oxDNA simulations using Bash in a high-performance computing environment
- Used Python tools such as Pandas and Seaborn to collect, aggregate, analyze, and plot large datasets

- Implemented a forward flux sampling to efficiently capture rare biological events on computationally feasible timescales

*Experimental project: Single-molecule DNA biophysics*

- Coded software in C++ to interact with scientific camera and other optical instruments via a user-friendly interface
- Created a collection of MATLAB scripts to process raw video data as well as analyze FRET trace data
- Designed and implemented a unique single-molecule DNA assay using molecular biology techniques
- Custom built a total internal reflection microscope

**Graduate Teaching Assistant**

2016 - 2019

School of Physics, Georgia Institute of Technology, *Atlanta GA*

- Developed students' problem solving and programming skills in group and individual settings
- Evaluated exams and study materials with instructors to improve course outcomes

**Private Tutor**

2013 - 2016

CollegeDrive Test Prep and Tutoring, *Denver CO*

- Interacted one-on-one with hundreds of high school students from all backgrounds for ACT, SAT & AP exams
- Designed custom lesson plans for each client to fit their goals and time-constraints
- Mediated difficult parent-student relationships, matching their expectations for better results

**Research Fellowship**

June 2015 - July 2015

National Institute of Standards and Technology, *Gaithersburg MD*

- Calibrated advanced mass sensor instruments used in ongoing work at a leading research organization during an 8-week summer program
- Independently learned to operate and extract data from a laser Doppler vibrometer
- Interpreted, visualized and presented critical results to a technical audience via oral presentation

**Laboratory Internship**

May 2014 - July 2014

Los Alamos National Laboratory, *Los Alamos NM*

- Explored using nuclear magnetic resonance methods to measure the water content in drought-stricken aspens in a 10-week summer program.
- Presented novel methods and results in both a written report and poster presentation

**PUBLICATIONS**

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Hart, D.J., Jeong, J., Gumbart, J.C., and Kim, H.D. (2022) Weak tension accelerates hybridization and dehybridization of short oligonucleotides. *bioRxiv* [in peer review]

**ORAL PRESENTATIONS**

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**Annual Meeting of the International Physics of Living Systems Network**

University of Montpellier, *Montpellier, France*

- Weak tension accelerates hybridization and dehybridization of short oligonucleotides 2022

**Physics of Living System Seminar**

Georgia Institute of Technology, *Atlanta GA*

- Kinetics of DNA melting and hybridization under small tension 2021
- How do DNA bending and twisting affect CRISPR-Cas12 binding and cleavage? 2019
- Tracking Polymer Tangles 2018

**Annual Meeting of the American Physical Society**

Virtual conference

- Nucleic acid melting under small tension 2021