

BOLUTITO BABATUNDE

tito.babatunde@gmail.com • (903) 520-5782 • <https://titobabatunde.github.io>

EDUCATION

Carnegie Mellon University

Doctor of Philosophy in Mechanical Engineering
Master of Science in Mechanical Engineering
Advisors: Dr. Rebecca E Taylor, Dr. Jonathan Cagan
GPA: 3.96 / 4.0

Pittsburgh, PA
August 2024
December 2022

Texas Tech University

Bachelor of Science in Mechanical Engineering
Minor: Computer Science, Mathematics
GPA: 3.90 / 4.0

Lubbock, TX
May 2019

SKILLS

Languages: Python, C++ (OpenGL), Bash, R, Perl

Frameworks: NumPy, SciPy, pandas, PyTorch, AWS, oxDNA MD Simulation, Agarose Gel Electrophoresis, Atomic Force Microscopy, DNA Nanotechnology

Software & Platforms: SLURM, Git, GATK, Clair3, PLINK2, Modkit, methyKit, bamql, coloc, STAR, fastp, Qualimap, IGV, tensorQTL, bedtools, samtools, FitHiC, Mustache, DiffHiC, ChimeraX, CaDNAAno, Scadnano

PROFESSIONAL DEVELOPMENT

AAI Introductory Course in Immunology (Parts 1 & 2)

American Association of Immunologists (AAI)

Los Angeles, CA
July 2025

RESEARCH EXPERIENCE

La Jolla Institute for Immunology and Allergy

POSTDOCTORAL RESEARCHER (NIH T32 Institutional Training Grant Fellowship)

San Diego, CA
October 2024 - Present

Investigating the effects of genetic variation on 5hmC (and 5mC) enhancer function in naïve CD4+ T cells

- Developing a long-read sequencing pipeline for 5hmC and 5mC QTL discovery in naïve CD4+ T cells with allele-specific validation using Oxford Nanopore Technologies (ONT) and nanoNOME-seq to expand the annotation of noncoding genetic variants associated with immune driven diseases
- Led the computation analysis of investigating 3D chromatin architecture differences across npTh17, pTh17, Th0, Th1, and Treg, integrating bulk RNA-seq and ATAC-seq with HiC-based loop inference
- Contributed to the multi-omic interpretation of aging-associated methylation in TEM, TEMRA, and nCD8+ cells by analyzing DMRs in the context of differential TE calls and bulk RNA-seq readouts

Carnegie Mellon University

GRADUATE RESEARCHER

Pittsburgh, PA
August 2019 - August 2024

Investigating a flexible framework for automating multilayer DNA origami design

- Developing a computational casting technique to automate solid and hollow DNA origami designs by casting a long single-stranded DNA (ssDNA) around or within a triangular mesh leveraging generative optimization strategies (i.e shape annealing)
- Integrating an adjustable ssDNA axis orientation feature to enhance design capabilities, influence structural density, uniformity, and generating novel routing patterns
- Created custom Python algorithms to convert generated designs into formats compatible with standard bioinformatic tools, scadnano, caDNAAno and oxDNA
- Developed a custom Python stapling algorithm to efficiently automate routing of hundreds of short oligonucleotides (or ssDNAs) to cinch long ssDNA routing patterns generated by computational casting technique
- Supervising an in-house lab technician to manufacture and characterize designs using gel-electrophoresis and collaborating with an Assistant Professor at University of Pittsburgh to ensure formation with transmission electron microscopy (TEM)
- Partnering with a PhD student to create new lab website and maintain Ubuntu 20.04 lab server and Amazon Web Services (AWS) Elastic Compute Cloud (EC2) instances for lab members

Los Alamos National Laboratory

Los Alamos, NM

- Constructed a functional prototype of a temperature controller connected to a chamber for heating specimens using Programmable Logic Controller (PLC) programmed with LABVIEW (systems engineering software) for remote system operation
- Designed temperature controller parts for machining with Creo (3D modeling software)
- Leveraged Robotic Operating System (ROS) and MoveIt to program a robotic arm to grab object for heating

ACADEMIC PROJECTS

(LTI-11685) Introduction to Deep Learning

Pittsburgh, PA

PROTEIN LANGUAGE MODELING: CODING LIFE'S CODE

August 2023 - December 2023

- Teamed up with master's student to modify the PyTorch-based SPOT-1D-LM model by incorporating ProteinBERT embeddings and integrating additional ResNet layers for single sequence analysis to investigate protein structure-function relationship
- Utilized modified SPOT-1D-LM to classify eight-state labels for protein secondary structure (SS8), achieving comparable accuracy, including on challenging Neff1-2020 set with no homologs (69.07%)
- Conducted an ablation study to eliminate overfitting by introducing weight decay and L1 regularization, leading to improved performance and validation loss stability from 5th epoch onward

(MEG-24787) Machine Learning and AI for Engineers

Pittsburgh, PA

CLASSIFYING SCAFFOLD ROUTINGS OF DNA ORIGAMI DESIGNS

August 2022 - December 2022

- Implemented a custom convolutional neural network (CNN) utilizing PyTorch for gap detection in cross-sectional view images of hollow designs produced by computational casting technique
- Partnered with PhD student to develop a custom CNN, achieving 73% accuracy for encapsulated ssDNA designs, outperforming VGG16 (86%) and ResNet50 (78%) showed increased loss after 20 epochs
- Improved accuracy to 92% by reclassifying dataset into three classes: large gap, small gap, and encapsulated

PUBLICATIONS

- **Babatunde, Bolutito**; Cagan, Jonathan; Taylor, Rebecca E. (2024). "An Improved Shape Annealing Algorithm for the Generation of Coated Deoxyribonucleic Acid Origami Nanostructures." ASME Journal of Mechanical Design. 146, no. 5: 051708. <https://doi.org/10.1115/1.4064242> (**Special Issue of the ASME Journal of Mechanical Design featuring top papers from IDETC 2023**)
- **Babatunde, Bolutito**; Arias, Sebastian D.; Cagan, Jonathan; Taylor, Rebecca E. (2021). "Generating DNA Origami Nanostructures through Shape Annealing." Applied Sciences. 11, no. 7: 2950. <https://doi.org/10.3390/app11072950>
 - *This paper introduces a novel approach to DNA origami design, overcoming limitations of current automated tools that primarily adopt a top-down approach. The novel approach uses the shape annealing algorithm to create a language that defines the relationships between sections of a long DNA strand and drives the language towards a preferred configuration. This method increases design complexity and codes unique characteristics into structures.*

CONFERENCES / PRESENTATIONS

- **Babatunde, Bolutito**; Wang, Rosan; Dasgupta, Nirmalya; Chakraborty, Abhijit; Ay, Ferhat (19-21 March 2025). "Investigating 5hmC enhancer function using short and long-read sequencing." 2025 LJI Scientific Retreat, UCLA Lake Arrowhead Lodge, Lake Arrowhead, CA, USA
- Benjaminson, Emma; **Babatunde, Bolutito**; Cagan, Jonathan; Taylor, Rebecca E. (24-27 September 2023). "Towards a Graph Neural Network Capable of Realistically Predicting DNA Nanostructure Equilibrium Dynamics" 2nd IACM Mechanistic Machine Learning and Digital Engineering for Computational Science, Engineering and Technology Symposium (MMLDE-CSET), University of Texas at El Paso, El Paso, TX, USA
- **Babatunde, Bolutito**; Cagan, Jonathan; Taylor, Rebecca E. (20-23 August 2023). "An Improved Shape Annealing Algorithm for the Generation of Coated DNA Origami Nanostructures." International Design Engineering Technical Conferences and Computers and Information in Engineering Conference (IDETC/CIE 2023), Boston Park Plaza, Boston, MA, USA
- **Babatunde, Bolutito**; Cagan, Jonathan; Taylor, Rebecca E. (8-12 August 2022). "A Refined Shape Annealing Algorithm for the Optimal Generation of DNA Origami Designs." DNA28: The 28th International Conference on DNA Computing and Molecular Programming (Track C), University of New Mexico, Albuquerque, NM, USA
- **Babatunde, Bolutito**; Cagan, Jonathan; Taylor, Rebecca E. (4 March 2022). "A Formal Automated Approach for Controlling the Wall Thickness of Coated DNA Origami Designs." 2022 PhD Research Symposium, Carnegie Mellon University, Pittsburgh, PA, USA. (**Best poster award in MicroNano Research**)
- **Babatunde, Bolutito**; Arias, Sebastian D.; Cagan, Jonathan; Taylor, Rebecca E. (12-15 April 2021). "A Formal Approach for Automated Generation of DNA Origami Designs." FNANO 2021: 18th Annual Conference Foundations of Nanoscience (Computational Tools), Virtual