Macy Mora-Antoinette

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Education

Cornell University | MSc & PhD in Mechanical Engineering **May 2024**
Focus: Imaging and Signal Processing *Ithaca, NY*

- **Ford Foundation Predoctoral Fellowship**: selected from competitive pool of PhD applicants (<5% acceptance rate) for 3 years of funding from the National Academies of Sciences, Engineering and Medicine (NASEM)
- **Bouchet Graduate Honors Society**: <10 inducted campus-wide each year for service and scholarship

Georgia Institute of Technology | MSc in Analytics **Aug 2023**
Focus: Machine Learning *Remote*

University of California, San Diego | BSc in Mechanical Engineering **Jun 2018**
Tau Beta Pi Engineering Honors Society *La Jolla, CA*

Experience

Cornell University **Aug 2018 – May 2024**
Graduate Research Assistant, Advisor: Karl Lewis *Ithaca, NY*

- Advanced imaging and data pipelines to advance osteoporosis research and prevent fragility fractures in the elderly
- Developed software (MATLAB) and hardware (PCB Design) for microscopy instrumentation and synchronizes dual-actuator system to remove up to 500% of artificial signal created by motion artifacts during *in vivo* imaging; increased data retention from 75% to 100%
- Accomplished segmentation of over 9000 cell bodies across 225GB of imaging data with filters, contrast adjustment, thresholds, and size exclusion; reduced processing times from days to hours, enhanced consistency, and minimized user bias from manual tracing
- Developed pipeline to process data sampled at 10Hz from time-series microscopy experiments; performed feature extraction, signal processing, Fourier analysis, and classification (MATLAB) of cellular responses
- Performed optical clearing of whole-mount tissues and acquired >1TB imaging data from light-sheet microscopy
- Reduced manual computation time from hours to minutes by scripting ImageJ Macros for rapid processing and analysis of hundreds of whole-bone 3D reconstructions from high resolution (microns) 3D X-ray scans
- Identified significant differences with statistical tests (A/B testing, ANOVA, ANCOVA, regression analysis) in R

Twitter **Jun – Aug 2022**
Data Science Intern *New York, NY*

- Performed people analytics by mapping software developers' perceptions of work enablement to software tool usage to identify bottlenecks in the system; joined time series and survey data in SQL across 3 different relational databases
- Used A/B testing and random forests in Python to identify unique tools for each engineer category; ran linear and ordinal logistic regressions to determine the relationship of tool usage and latency on work enablement
- Used package "spacy" to identify general sentiments for these tools in the "open ended" comments section of surveys, which agreed well with results
- Presented final outcomes and created significant interest among stakeholders, specifically heads of research

Instito Técnico Ortopédico (ITOSA) **Jun – Jul 2018**
Engineering Intern *Barcelona, Spain*

- Applied Computer Aided Design and Manufacturing (CAD-CAM) to create pediatric scoliosis corsets and other orthotics that were personalized for patients
- Designed website prototypes and assisted with Spanish and English translations to reach patients from different countries

Massachusetts Institute of Technology **Jun – Aug 2017**

Engineering Intern, Advisor: Robert Langer *Cambridge, MA*

- Automated manufacturing process of large-dose tuberculosis drug delivery device by programming a Computer Numeric Control (CNC) mill and laser cutter combined with a pill press in efforts toward future mass production and availability
- Performed Instron tensile testing and acid-resistant tests on device materials to see if it could withstand stomach conditions long-term

Massachusetts Institute of Technology **Jun – Aug 2016**

Engineering Intern, Advisor: Robert Langer *Cambridge, MA*

- Engineered disruptive technologies for drug delivery systems for tuberculosis in low-resource environments
- Designed hardware for smart system connected to magnetic sensor and Arduino circuit to fit into a nasogastric tube to autonomously identify and retrieve a non-biodegradable drug delivery device retained within the stomach
- Received return offer and co-authorships in *Science Translational Medicine* and on a US patent application

University of California, San Diego **May 2015 – May 2018**

Undergraduate Research Scholar, Advisor: Shu Chien *La Jolla, CA*

- Applied cyclic mechanical stretch on stem cells cultured on silicon membrane to mimic a beating heart and develop a platform for cardiac tissue engineering; executed wetlab procedures including cell culture, western blot, and qPCR
- Received the Chancellor's Research Excellence Scholarship; presented findings with fully funded travel awards at 3 national conferences

Academic Appointments

Cornell University **Aug – Dec 2019**

MAE 3270 Teaching Assistant *Ithaca, NY*

- Instructed 3 hour labs for the undergraduate course Mechanics of Engineering Materials; apply lab safety with mechanical testing systems (MTS).
- Graded quizzes and exams; hosted office hours

Skills

Programming: Python, MATLAB, R, SQL

Machine Learning Frameworks: PyTorch, Scikit-Learn

Data Analytics and Visualization: Pandas, NumPy, Matplotlib, Seaborn, SAS (Prism and JMP)

Cloud and Data Warehousing Platform: Google Cloud Platform (GCP), BigQuery

Statistics and Algorithms: ANOVA/ANCOVA, A/B testing, regression, random forests, Principal Component Analysis, Support Vector Machines (SVM), Deep Learning (Transformer-Encoder, RNN, TCN)

Image and Signal Processing: forecasting, classification, feature extraction, Fourier analysis, ImageJ Macros

Machine Learning Projects

Human Motion Prediction **Jan – May 2021**

Tools: Deep learning, Temporal-Convolutional Network, RNN, Transformer-Encoder

- Leveraged the largest Archive of Motion Capture as Surface Shapes to create robust models for motion capture sequences across applications in biomechanics, animation, and sports; hyperparameter tuning increased efficiency
- Achieved 95% reduction to validation error loss compared to baselines models, improving motion prediction

Predictive Sports Analytics **Aug– Dec 2020**

Tools: SVM, Random Forest, Logistic Regression, Naive Bayes, AdaBoost, KNN, and QDA

- Predicted top 5 ranking soccer teams in the English Premier League based on game outcome predictions using multiclassifier models (win, loss, draw) that analyzed 6,800 games across 18 years in soccer
- Utilized mutual information theory and rolling/cumulative statistics for feature selection

Algorithmic Trading **Aug – Dec 2020**

Tools: Random Forest, Simulation, Time-Series Forecasting

- Developed stock market trading algorithm combining three market indicators within a Random Forest model that performs market history analysis and outputs recommended trades.
- Achieved 49% normalized return on investment after backtesting model across a 2 year time span.

Awards and Fellowships

2023 Edward A. Bouchet Graduate Honor Society.
2022 Travel Award from Kappa Delta for Orthopedic Research Society Annual Meeting
2022 Young Investigator Award
2021 Mong Cornell Neurotech Fellowship
2020 Ford Foundation Predoctoral Fellowship
2020 NSF Graduate Research Fellowship - Honorable Mention
2017 Chancellors Research Excellence Scholarship
2017 National Action Council for Minorities in Engineering (NACME) Scholarship
2017 Tau Beta Pi Engineering Honors Society
2017 Travel Award for MolES Research Symposium at University of Washington-Seattle
2017 Travel Award for Annual Biomedical Research Conference for Minority Students (ABRCMS)
2016 UC LEADS Scholar (Declined)
2015 IMSD NIH Undergraduate Scholar
2014 Butte Creek Foundation Scholarship

Presentations

[1] "Nicotinic Acetylcholine Receptors on Osteocytes Impact Bone Mechanoadaptation," for 9th World Congress of Biomechanics, Taipei, Taiwan. Jul 10-14, 2022.

[2] "Cholinergic Signaling Impacts Osteocyte Mechanotransduction," for Orthopedic Research (ORS) 2022 Annual Meeting, Tampa, FL. Feb 4-8, 2022.

[3] "Alterations to the Gut Microbiome Impair Bone Tissue Strength in Aged Mice," for American Society for Bone and Mineral Research Annual Meeting (ASBMR) Virtual. Sept 11-15, 2020.

[4] "Cholinergic Signaling Impacts Osteocyte Mechanotransduction," for for 10th Annual Musculoskeletal Repair and Regeneration Symposium Virtual. Oct 20, 2021

[5] "Hematopoietic Stem Cells Modulate Macrophage Inflammation Phenotype through MicroRNA-126-dependent Signaling," for Annual Biomedical Research Conference for Minority Students (ABRCMS), Phoenix, AZ. Nov 1-4, 2017.

[6] "Mechanical Stretch Promotes Pluripotent Stem Cell Cardiac Differentiation via miR-1-Dependent Signaling," for Society for Advancement of Chicanos and Native Americans in Science (SACNAS), Salt Lake City, UT. Oct 19-21 2017.

[7] "Hematopoietic Stem Cells Modulate Macrophage Inflammation Phenotype through MicroRNA-126-dependent Signaling," for Molecular Engineering and Sciences Institute Undergraduate Research Symposium, University of Washington-Seattle. Aug 16, 2017.

[8] "Effects of Apelin-APJ on Human Embryonic Stem Cell Derived-Cardiomyocyte Contractility and Electrophysiology," for Chancellor's Excellence Research Scholarship Symposium, University of California, San Diego. Oct 31, 2017.

[9] "Aspects of Drug Delivery Devices: Drug Release and Device Localization in the Body," for MIT Summer Research Program, Massachusetts Institute of Technology, MA. August 10, 2017.

[10] "Sustained Diffusion for Drug Release in Gastroretentive Systems" for MIT Summer Research Program, Massachusetts Institute of Technology, MA. August 4, 2016.

Publications

*other names: Macy Castaneda

[1] M Mora-Antoinette, M Obaji, A Saffari, KJ Lewis,"Nicotinic Acetylcholine Receptors on Osteocytes Impact Bone Mechanoadaptation in a Sexually Dimorphic Manner," Cold Spring Harbor Laboratory. *BioRxiv* 2023. doi: https://doi.org/10.1101/2023.10.01.556129

[2] KJ Lewis, JJ Boorman-Padgett, M Castaneda, DC Spray, MM Thi, MB Schaffler, "A Fluorescent Intravital Imaging Approach to Study Load-Induced Calcium Signaling Dynamics in Mouse Osteocytes," *Journal of Visualized Experiments* 2023. doi: https://doi.org/10.3791/64366

[3] M Castaneda, KM Smith, JC Nixon, CJ Hernandez, and S Rowan, "Alterations to the gut microbiome impair bone tissue strength in aged mice," *Bone Reports* 2021. doi: 10.1016/j.bonr.2021.101065.

[4] M Castaneda, JM Strong, DA Alabi, CJ Hernandez, "The Gut Microbiome and Bone Strength," *Current Osteoporosis Reports* 2021. doi: 10.1007/s11914-020-00627-x

[5] M Luna, JD Guss, LS Vasquez-Bolanos, M Castaneda, *et al*, "Components of the Gut Microbiome That Influence Bone Tissue-Level Strength," *Journal of Bone and Mineral Research* 2020. doi: doi.org/10.1002/jbmr.4341

[6] CG Traverso, RS Langer, M Verma, N Roxhed, F Eweje, M Castaneda *et al*, "Retrieval systems and related methods," *US Patent Application* 2019. No. US16/427,414

[7] M Verma, K Vishwanath, F Eweje, N Roxhed, T Grant, M Castaneda, *et al*, "A gastric resident drug delivery system for prolonged gram-level dosing of tuberculosis treatment," *Science Translational Medicine* 2019. doi: 10.1126/scitranslmed.aau6267

Undergraduate Research Mentorship

[1] Alexander Saffari (2022-2023), Current: Senior at Cornell University

[2] Mariam Obaji (2021-2023), Current: PhD Student at Washington University in St. Louis

[3] Emily McGrath (2021-2022), Current: PhD Student at UC Berkeley

[4] Jacob Nixon (2019-2020), Current: PhD Student at University of Pennsylvania

[5] Denise Alabi (2019-2020), Current MD Student at Icahn School of Medicine at Mount Sinai

[6] Julio Rivera (2019), Current: PhD Student at UC Berkeley

Leadership and Outreach

GMSU Academic Diversity Initiatives, Cornell **Oct 2021 – May 2022**
Graduate Student Mentor *Ithaca, NY*

- Mentored a group of 3 undergraduates, meeting monthly, and guiding them through their studies

Village at Ithaca **Jul – Dec 2019**
Tutor *Ithaca, NY*

- Tutored two middle school students in mathematics twice each week

CURIE Academy, Cornell — **Jul 2017**

Instructor — *Ithaca, NY*

- Instructed daily, four-hour long laboratories on protein quantification a for high school science camp to encourage young girls to join STEM careers

Expanding Your Horizons, Cornell — **Apr 2017**

Instructor — *Ithaca, NY*

- Spearheaded a workshop for day-long conference where hundreds of high school girls come to learn about STEM careers; in my workshop, students alongside their parents prototyped designs for an artificial knee

Project Bell Saturday Academy — **Nov 2015 - May 2018**

President (year 3), VP (year 2), Instructor (year 1) — *San Diego, CA*

- Organized Saturday school for middle schoolers at risk of not graduating; provided homework help, math tutoring, & science activities
- Accommodated 50+ students several weekends; built collaborations, secured transportation (30min commute), recruited tutors, fund raised

Office for Students with Disabilities, UCSD — **Mar 2016 - Jun 2017**

Note Taker — *La Jolla, CA*

- Took class notes for a student with disabilities in a mechanical engineering course and Latin American history course

Fellowship for International Service and Health, UCSD — **Oct 2015 - Mar 2016**

Volunteer — *Tijuana, Mexico*

- Volunteered at orphanages in Tijuana, Mexico; donated food and school supplies