Maria Cardei
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Research Interests

My research interests lie in applied machine learning. With expertise in both computer science and biomedical engineering, I bring a highly interdisciplinary approach to developing multi-modal, data-driven solutions for high-dimensional data in applied sciences. I thrive in collaborative, interdisciplinary teams and am eager to apply my experience to new challenges, continually seeking to learn and explore innovative approaches.

Education

- **Ph.D. in Computer Science —** Expected 2028
  University of Virginia, Charlottesville, VA, USA (Advisor: Professor Afsaneh Doryab)
  - GPA: 4.0
  - NSF GRFP Fellowship
  - Provost Fellowship
  - NSF NRT Fellowship
- **Masters in Computer Science —** May 2025
  University of Virginia, Charlottesville, VA, USA (Advisor: Professor Afsaneh Doryab)
  - GPA: 4.0
- **B.S. in Biomedical Engineering, minor in Computer Science** — May 2023
  University of Florida, Gainesville, FL, USA
  - GPA: 3.94

Publications

- **M. Cardei**, J. Lamp, M. Derdzinski, K. Bhatia, “DM-Bench: Benchmarking LLMs for Personalized Decision Making in Diabetes Management”, Preprint available at arXiv:2510.00038 [cs.LG], *paper in submission to ICLR*.

- A. Balch, **M. Cardei**, S. Kranz, A. Doryab, "Towards an Accessible, Noninvasive Micronutrient Status Assessment Method: A Comprehensive Review of Existing Techniques", paper in *ACM Transactions on Computing for Healthcare*, 2025.

- A. Balch, **M. Cardei**, A. Doryab, “Exploring Smartphone-based Spectrophotometry for Nutrient Identification and Quantification”, Preprint available at arXiv:2410.11027 [physics.med-ph]. Poster to be presented at *Ubicomp,* 2025 in Espoo, Finland.

- **M. Cardei**, A. Doryab, “Factorized Deep Q-Network for Cooperative Multi-Agent Reinforcement Learning in Victim Tagging”, Preprint available at arXiv:2503.00684 [cs.MA]. Paper recently accepted to *IEEE Transactions on Automation Science Engineering, 2025.*

- M. Clark*, **M. Cardei***, C. Zhao, I. Cardei, R. Yan, A. Doryab, "The Human Rhythms Dataset: Connecting Cyclical Human Behaviors and Wellness", paper recently accepted to *Nature Scientific Data.*

- C. Zhao*, **M. Cardei***, M. Clark*, R. Yan, A. Doryab, "Capturing Biobehavioral Rhythms in Everyday Life: Data and Models for Cyclic Behavior in Naturalistic Settings", paper recently accepted to *ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies (IMWUT)*.

- **M. Cardei**, S. Ahmed, G. Chapman, A. Doryab, "Pairwise Spatiotemporal Partial Trajectory Matching for Co-Movement Analysis", Preprint available at arXiv:2412.02879 [cs.CV].

- **M. Cardei**, A. Doryab, "Practical Heuristics for Victim Tagging During a Mass Casualty Incident Emergency Medical Response", paper in *2024 IEEE 20th International Conference on Automation Science and Engineering (CASE)*, Bari, Italy 2024.

- **M. Cardei**, A. Doryab, "Multi-Agent System for Optimizing Victim Tagging in Human/Autonomous Responder Team", abstract in *2024 15th ACM/IEEE International Conference on Cyber-Physical Systems (ICCPS)*, Hong Kong, China 2024.

- S. Davidashvilly, **M. Cardei**, M. Hssayeni, C. Chi, B. Ghoraani, "Deep neural networks for wearable sensor-based activity recognition in Parkinson's disease: investigating generalizability and model complexity", paper in *Biomedical Engineering Online.* 2024.

* Authors contributed equally

Research & Experience

- Graduate Research Assistant — August 2023-present
  University of Virginia, Charlottesville, VA, USA (Advisor: Professor Afsaneh Doryab)
  - Designing an accessible device to non-invasively assess internal biological processes.
  - Developing an image analysis-based framework for detecting movement patterns using partial trajectory matching, incorporating object detection and Siamese Neural Networks.
  - Analyzing human behavioral rhythms through machine learning techniques.
  - Formulating a multi-agent problem and designed distributed heuristics for scalable simulation, employing agent-based modeling for generalizable solutions.
  - Applying a new multi-agent factorized deep Q-network reinforcement learning approach to the victim tagging problem.
  - Contributing to the development and application of a novel image representation approach to enhance human activity recognition and identify behavioral variations within and across individuals.

- ML and AI Engineer Intern – May-September 2025
  Dexcom, Remote Position

- Led end-to-end development of a large-scale LLM benchmarking framework for personalized decision-support in diabetes management, spanning task and data generation, model evaluation, and analysis.
- Built and deployed cloud-based infrastructure on Google Cloud Platform (Vertex AI, Model Garden, BigQuery, GCS) to run 2.8M evaluations across 15K users.
- Designed and implemented multi-metric evaluation pipeline assessing accuracy, safety, groundedness, clarity, and actionability of LLM outputs.
- Collaborated with Dexcom's Data Products & AI team to align research with real-world diabetes decision-support applications.
- First-author on a research paper submitted to a top-tier machine learning conference.

- Machine Learning for Image Analysis Course Project – Fall 2024
  University of Virginia, Charlottesville, VA, USA
  - Implemented supervised contrastive learning for the classification of medical brain scan images, enhancing model performance for accurate diagnostics.

- Natural Language Processing Course Project – Fall 2024
  University of Virginia, Charlottesville, VA, USA
  - Curated and pre-processed data for a Retrieval-Augmented Generation (RAG) model to support a science tutoring system for 5th grade students.
  - Contributed to the overall LLM architecture and front-end/back-end integration.
  - Utilized Python, GPT, Django, React, HTML, CSS, and GitHub for development.
  - Evaluated output quality based on reading ease and grade level using Flesch-Kincaid Grade and Flesch Reading Ease scales.

- Human-Robot Interaction Course Project —Spring 2024
  University of Virginia, Charlottesville, VA, USA
  - Designed and performed controlled user study with NAO robot to test robot persuasiveness in a customer service setting.
  - Programmed NAO robot to recognize speech and have an interaction with participants.
  - Use statistical analyses to determine robot persuasiveness.

- Signal Processing, Machine Learning, and Control Course Project — Fall 2023
  University of Virginia, Charlottesville, VA, USA
  - Used a smartwatch (ASUS Zenwatch 2) for human activity recognition.
  - Collected and pre-processed data, and implemented more than 10 machine learning models and sequential feature selection for human activity recognition.

- NSF REU Research Intern — May 2022-January 2023
  Florida Atlantic University Institute for Sensing and Embedded Network Systems Engineering (I-SENSE), Boca Raton, FL, USA (Mentor: Professor Behnaz Ghoraani)
  - Applied domain adaptation techniques with Python to generalize human activity recognition models to the Parkinson's population.
  - Evaluated deep learning model complexity and data augmentation strategies.

- Senior Design Project in Collaboration with HangTech LLC — August 2021-May 2022
  University of Florida, Gainesville, FL, USA
    - Designed a device and system that detects and classifies tremors for Parkinson's and Essential Tremor patients.
    - Collected accelerometer data with Arduino.
    - Utilized MATLAB and Python to develop a machine learning classification model.

- REU Research Intern — May-August 2021
  Wake Forest Center for AI Research, Winston Salem, NC, USA (Mentor: Professor Metin Gurcan)
    - Detected cell nuclei in medical pathology images using deep learning and image processing techniques.
    - Implemented Faster R-CNN models and pre-processed medical imaging datasets with MATLAB and Python.
    - Researched and presented advanced object detection algorithms.

- Computer Applications for Biomedical Engineering Course Project — Fall 2020
  University of Florida, Gainesville, FL, USA
    - Detected Diabetic Retinopathy (DR) in fundus images using image processing techniques.
    - Developed a MATLAB model to import dataset, preprocess images, eliminate vessels, subtract optic disks, segment exudates, and classify DR severities.

Technical Skills & Tools

Programming Languages: Python, MATLAB, C++, Java
Machine Learning & Data Science Frameworks: TensorFlow, PyTorch, Scikit-learn, OpenCV
Large Language Models (LLMs): Prompt engineering, model evaluation, benchmarking
Cloud & Data Infrastructure: Google Cloud Platform (Vertex AI, Model Garden, BigQuery, GCS), Microsoft Azure, parallelized workflows
Data Analysis: Pandas, NumPy, SciPy
High-Dimensional Data Analysis: Multi-modal data integration, feature extraction, biomarker and behavioral data analysis, model training and evaluation
Deep Learning & Specialized Techniques: Reinforcement learning, CNNs, Siamese Neural Networks, image and medical image analysis, object detection
Software & Development Tools: Google Colab, Jupyter Notebooks, Git, Docker
Data Visualization: Matplotlib, Seaborn, Plotly

Teaching Experience

- Graduate Teaching Assistant for Signal Processing, Machine Learning, and Control (CS6762) — Fall 2025
  University of Virginia, Charlottesville, VA, USA
    - Delivered guest lecture, and oversaw all grading for a class of 58 students.

- Graduate Teaching Assistant for Foundations of Data Analysis (CS3501) — Spring 2025

University of Virginia, Charlottesville, VA, USA

- Conducting weekly office hours and responding to student queries via Piazza, providing academic support to 74 students on course concepts and assignments.
- Grading assignments, midterm, and final exams, ensuring accuracy, consistency, and constructive feedback to enhance student understanding.

- Graduate Teaching Assistant for Computational Behavior Modeling (CS6501) — Fall 2024
  University of Virginia, Charlottesville, VA, USA
  - Managed assignments, hosted office hours, and aided discussion for 17 graduate students.

- Teaching Assistant — June-August 2023
  Girls Who Code Summer Immersion Program, Virtual
  - Delivered an engaging game design curriculum to high school girls (JavaScript,p5.js).
  - Collaborated with the teaching team to foster an inclusive environment for students to explore the STEM field.
  - Debugged and checked over student projects during office hours, personalized assistance.

- Teaching Assistant for Elements of Electrical Engineering (EEL3003) — Fall 2020
  University of Florida, Gainesville, FL, USA
  - Taught students course material at weekly office hours.
  - Responsible for grading assignments and Arduino Build Reports.

Course Experience

Graduate:

Analyzing Online Behavior for Public Health; Machine Learning in Systems Security; Machine Learning for Image Analysis; Natural Language Processing; Machine Learning; Human-Robot Interaction; Cyber-Physical Systems: Formal Methods, Safety and Security; Cyber-Physical Systems: Technology and Ethics; Computational Behavior Modeling; Signal Processing, Machine Learning, and Control

Undergraduate:

Introduction to Data Science, Introduction to Multimodal ML in Python, Operating Systems, Introduction to Computer Organization, Data Structures/Algorithms, Programming Fundamentals 1 & 2, Applied Discrete Structures, Clinical Engineering Design, Quantitative Physiology, Computer Applications for Biomedical Engineering, Biosignals & Systems, Biomedical Instrumentation

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Professional Service & Engagement

- Building Leaders for Advancing Science and Technology (BLAST) STEM Career Panelist – August 2025
  University of Virginia, Charlottesville, VA, USA
  - Spoke on a panel to 80 rising 9th and 10th grade high school students about career paths in science and engineering.

- Women in Computer Science (WiCS) Hackathon Workshop Leader — February 2025
  University of Virginia, Charlottesville, VA, USA
  - Led the Research Workshop at the UVA WiCS Hackathon.

- Shared insights on research inspiration, project experience, and technical skills to inspire and guide participants.
- Engaged with aspiring undergraduate researchers to encourage participation in computer science research.

- Paper Reviewer — March 2024 - present
  University of Virginia, Charlottesville, VA, USA
  - Provided reviews of 5 potential publications for *ACM Transactions on Computing for Healthcare* and *IMWUT.*

- Wake Forest Biomedical Informatics Internship Alumni Panelist — June 2023
  Wake Forest University, Winston Salem, NC, USA
  - Invited to speak at "How to Find the Right Career Path" discussion panel for current undergraduate student interns.
  - Sparked insightful discussion about career paths and inspired students to consider graduate school.

- Content Co-developer and Co-teacher — June 2022
  Florida Atlantic University I-DeepLearn Summer Outreach Program, Boca Raton, FL, USA
  - Co-developed and delivered curriculum for I-DeepLearn summer outreach program.
  - Introduced high school girls to deep learning through hands-on projects.

Leadership & Volunteering

- Charlottesville High School Mentorship Program Mentor— Fall 2024
  University of Virginia, Charlottesville, VA, USA
  - Co-mentor senior high school student in his engineering capstone project.
  - Weekly check-ins with student to assist with technical questions and time management.

- Fluvanna SPCA Website Designer and Developer – May 2024 - present
  Fluvanna County Society for the Prevention of Cruelty to Animals, VA, USA
  - Collaborate in bi-weekly meetings to align on design goals and strategies.
  - Develop and optimize the website to effectively showcase the organization and support animal adoptions.

- Computer Science Graduate Student Group Social Chair — January 2024 - present
  University of Virginia, Charlottesville, VA, USA
  - Coordinate, plan, and run 2-3 social events every month for CS graduate students.
  - Elected by computer science graduate students for a one-year term.

- Outreach Event Volunteer — January 2024 - present
  University of Virginia, Charlottesville, VA, USA
  - Represented the UVA CS graduate program at 3 graduate and faculty recruitment events.
  - Panelist at new graduate student orientation discussion "What to Expect at UVA CS".

Accomplishments, Awards, and Honors

- UVA President's Provost Fellowship — August 2023-August 2028
- NSF GRFP – 2025
- NSF National Research Traineeship (NRT) (Cyber-Physical Systems) — August 2023-August 2024
- Computer Science Scholar — August 2023- May 2024
- Poster Presentation: **M. Cardei**, H. Binol, M. Gurcan, L. Cooper, D. Jaye, Nuclei Detection in Immunohistochemical Images of Diffuse Large B-Cell Lymphoma using Deep Learning, *Biomedical Engineering Society (BMES) Conference,* October 2021.
- President's Honor Roll — May 2020
- Florida Bright Futures Scholarship – July 2018-May 2023