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EDUCATION

Vanderbilt University **Nashville, TN** **Aug 2021 – May 2026 (Expected)**
- Dual Program of Master's and Ph.D. in Computer Science (Ongoing)
- **Highlighted Coursework:** Representation Learning in DL, Open Source Imaging, HCI, Internet of Medical Things

University of California, Irvine **Irvine, CA** **Aug 2017 – Jun 2021**
- Bachelor of Science in Computer Science, Magna cum Laude (top 6%) GPA: 3.89
- **Highlighted Coursework:** Data Mining, Projects in Databases and Web Applications, Applications of Probability in Computer Science

AWARDS

- **IEEE/ACM CHASE 2024 NSF Travel Award (Grant):** Honored for research excellence and presentation in Wilmington, Delaware. Received the NSF Travel Award, acknowledging the high esteem of the accepted paper.
- **Vanderbilt Awards for Doctoral Discovery (VADD):** Awarded for research excellence and presentation in Wilmington, Delaware, at Vanderbilt University.
- **ICCPS 2024 NSF Travel Grant:** Recognized for research excellence to travel to Hong Kong to further develop research skill in the domain of Cyber-Physical System.
- **UbiComp/ISWC 2023 Travel Grant:** Recognized for the research work and presented at Cancun, Mexico for accepted paper.
- **Vanderbilt University Travel Grant:** Recognized for the research work in the intersection of physical therapy and AI, traveling to present the work in 2023.
- **Magna Cum Laude:** Recognized for academic excellence by Donald Bren School of Information and Computer Science at UC Irvine
- **Specialization in Intelligent Systems:** Achieved specialization through dedicated coursework and projects at UC Irvine
- **Dean's Honor List:** (2017-2021) Consistently maintained high GPA to be recognized on the Dean's List at UC Irvine

PUBLICATIONS

[1] **Wang, Hanchen David**, Bae, Siwoo, Sun, Xutong, Thatigotla, Yashvitha, and Ma, Meiyi. "EXACT: A Meta-Learning Framework for Precise Exercise Segmentation in Physical Therapy". *International Conference on Cyber-Physical Systems (ICCPS)*, Nov. 2024, **Under Review**.

[2] **Wang, Hanchen David**, Bae, Siwoo, Chen, Zirong, and Ma, Meiyi. "Learning with Preserving for Continual Multitask Learning". *International Conference on Learning Representations (ICLR)*, Oct. 2024, **Under Review**.

[3] Cohn, Clayton, Davalos, Eduardo, Vatral, Caleb, Fonteles, Joyce, **Wang, Hanchen David**, Ma, Meiyi, and Biswas, Gautam. "Multimodal Methods for Analyzing Learning and Training Environments: A Systematic Literature Review". *ACM COMPUTING SURVEYS*, Aug. 2024, **Under Review**.

[4] Lopez, Diego Manzanas and Liu, Han and **Wang, Hanchen David**, Moyer, Daniel, Ma, Meiyi, Johnson, Taylor T., and Oguz, Ipek. "Robustness Certification of Semantic Segmentation of Multiple Sclerosis Lesions". *SPIE*, Aug. 2024, **Under Review**.

[5] **Wang, Hanchen David**, Robinette, Preston K., Lopez, Diego Manzanas, Oguz, Ipek, Johnson, Taylor T., and Ma, Meiyi. "ReachX: Abstraction-based Reachability Verification for Targeted and Robust eXplainable AI". Aug. 2024, **Under Revision**.

[6] **Wang, Hanchen David**, Khan, Nibraas, Chen, Anna, Sarkar, Nilanjan, Wisniewski, Pamela, and Ma, Meiyi. "MicroXercise: A Micro-Level Comparative and Explainable System for Remote Physical Therapy". *Connected Health: Applications, Systems and Engineering Technologies (CHASE)*, Mar. 2024. https://doi.org/10.1109/CHASE60773.2024.00017.

[7] Robinette, Preston K., **Wang, Hanchen David**, Shehadeh, Nishan, Moyer, Daniel, and Johnson, Taylor T. "SUDS: Sanitizing Universal and Dependent Steganography". *Proceedings of the 26th European Conference on Artificial Intelligence*. Sept. 2023, arxiv.org/abs/2309.13467.

[8] **Wang, Hanchen David** and Ma, Meiyi. "PhysiQ: Off-Site Quality Assessment of Exercise in Physical Therapy". *Proc. ACM Interact. Mob. Wearable Ubiquitous Technol.*, vol. 6, no. 4, Dec. 2022. https://doi.org/10.1145/3570349.

RESEARCH

Explainable AI for First-Person Video Segmentation in Nursing Simulations **Python, PyTorch** **Jul 2024 – Current**
- *Collaborated with Daniel Levin, Gautam Biswas, Alyssa White, and advised by Meiyi Ma*

- Leading a project to develop explainable AI methods for analyzing video segments from Tobii Glasses' first-person perspective during nursing simulation training sessions.
- Focused on creating interpretable segmentation models that assist nursing students and educators in understanding how attention and gaze dynamics correlate with task performance and learning outcomes.
- Designed and implemented a novel unsupervised segmentation method optimized for processing long videos efficiently, enabling rapid analysis without the need for extensive labeled data.
- Evaluated the model's ability to identify and segment key moments, providing actionable insights and improving the effectiveness of nursing education and simulation training.
- Explored state-of-the-art explainability techniques to ensure the segmentation outputs are both accurate and intuitive for non-technical users in healthcare education.

IMU-Guided Segmentation and   **Python, PyTorch**   **Feb 2024 – <u>Current</u>**
Sampling for Video Classification

- *Collaborated and advised by Meiyi Ma*
- Leading a project to develop an IMU-guided method for segmenting and sampling video frames, enhancing classification accuracy and efficiency in multimodal data.
- Addressing limitations of Temporal Segment Networks (TSN), which rely on equidistant segmentation and random sampling, by incorporating motion-based insights from IMU data to guide frame selection and feature extraction.
- Conducted extensive evaluations and experiments with state-of-the-art methodologies to demonstrate the effectiveness of this approach in capturing relevant features and improving model performance.
- Focused on designing a pipeline that leverages IMU signals to dynamically identify and prioritize key segments in video data, reducing redundancy and enhancing classification robustness.

Learning with Preserving for   **Python, PyTorch**   **Jan – Oct 2024**
Continual Multitask Learning

- *Collaborated and advised by Meiyi Ma*
- Leading the initiative on a novel methodology for Continual Multitask Learning (CMTL), focusing on retaining previously learned knowledge while integrating new tasks without requiring access to prior data or extensive replay buffers.
- Developed the Learning with Preserving (LwP) framework, featuring a Dynamically Weighted Distance Preservation loss function to maintain representation integrity across tasks. This approach addresses challenges unique to CMTL, which go beyond traditional Continual Learning (CL) and Multitask Learning (MTL).
- Conducted extensive evaluations on benchmark datasets, including inertial measurement units of multivariate time series data for exercise quality assessment and image datasets, demonstrating the robustness and generalizability of LwP in mitigating catastrophic forgetting.
- Collaboratively authored the paper *Learning with Preserving for Continual Multitask Learning*, under review at the International Conference on Learning Representations (ICLR) 2024.

ReachX: Star-based Reachability   **Python, PyTorch, MatLab**   **Sep 2023 – May 2024**
Verification for Targeted and
Robust eXplainable AI

- *Collaborated with Meiyi Ma, Taylor Johnson, and Diego Manzanas Lopez; advised by Meiyi Ma*
- Co-leading this project with Diego Manazanas Lopez, developing a framework to evaluate and test the comprehensiveness of the SOTA attribution methods.
- Utilizing Neural Network Verification (NNV) to evaluate and validate the boundary and trustworthiness of different sampling-based attribution methods.

EXACT: A Meta-Learning   **Python, PyTorch**   **May 2023 – June 2024**
Framework for Precise Exercise
Segmentation in Physical Therapy

- *Collaborated and advised by Meiyi Ma*
- Leading the project and developing a novel method for segmenting exercises within multivariate time series data. This involves the development and implementation of deep learning models using PyTorch to accurately identify and categorize different exercise phases from complex sensor data.
- Integrated dense labeling techniques with state-of-the-art neural network architectures, improving segmentation precision and reliability.
- Designed and executed comprehensive experiments to validate our method's effectiveness across various datasets, showcasing its adaptability and superiority over traditional segmentation techniques.
- Contributed to the development of a modular software framework in Python that facilitates easy replication of our model, experimentation with different network architectures, and adaptation to other time series segmentation tasks.

Sanitizing Universal and Dependent Steganography   Python, PyTorch, TensorFlow, Java   Oct 2022 – May 2023

- *Collaborated with Professor Daniel Moyer, Taylor Johnson, and Meiyi Ma*
- Collaborated with 2 other researchers and developed SUDS (Sanitizing Universal and Dependent Steganography), a deep learning-based sanitization technique that mitigates the limitations of steganalysis.
- Conducted experiments and research to demonstrate the capabilities and limitations of this methods.
- Re-implemented stenographic traditional method as a loss function into deep learning methods in Python
- Integrated into docker for reproducibility purpose

MicroXercise: A Micro-Level Comparative and Explainable System for Remote Physical Therapy   Python, Pytorch, Swift, C#, Unity   Aug 2022 – May 2023

- *Collaborated with Professor Meiyi Ma and Pamela Wisniewski; advised by Professor Meiyi Ma.*
- Lead author of this project, investigated the essential role of physical exercises in promoting health and well-being, with a particular focus on physical therapy (PT) rehabilitation and recovery routines.
- Leading this project, and developing a variant of Siamese Neural Networks that not only determines the similarity between two inputs but also provides a detailed attribution score on these two inputs.
- Incorporating saliency map techniques or layer-wise relevance propagation into the Siamese architecture to achieve interpretability and explainability on different modalities of inputs, such as images and signals.
- Utilizing Python and PyTorch for the implementation of the Siamese Neural Network and integrating saliency map techniques or layer-wise relevance propagation algorithms.
- Designed a comprehensive feedback system with visual and textual components that provide insights into user performance with IMU sensory data.
- Conducted a mixed-methods study to evaluate the system's effectiveness and user perception, involving semi-structured interviews, surveys, and quantitative analysis.
- Emphasized the role of such a system in fostering self-awareness among users, serving as an observer during exercise sessions, and encouraging users to think about their mind-muscle connection—an essential element for physical therapy.

Literature Review: Multimodal Methods for Learning and Training Environments   Python   Jun 2022 – <u>Current</u>

- *Collaborated with Professor Meiyi Ma and Gautam Biswas; advised by Professor Meiyi Ma.*
- Collaborated with 4 other researchers, conducted a comprehensive review of publications employing multimodal techniques for the enhancement of learning and training environments, ranging from physical domains (e.g. physical therapy), to mixed-reality scenarios (e.g. manikin-based nursing training in simulated emergency rooms), and online learning platforms (e.g. physics learning via computer software).
- Defined *multimodal environments* as scenarios where data from at least two modalities are analyzed, with a *modality* being a unique task performed with one or more data streams.
- Constructed and presented tables detailing various devices, their corresponding sensors, and the modalities they represent, as well as the practical applications of these modalities and the tasks they are utilized for.

PhysiQ: Off-site Quality Assessment of Exercise in Physical Therapy   Python, Pytorch, Swift   August 2021 – May 2022

- *Collaborated and advised by Meiyi Ma*
- Lead author of this project, discussed the integral role of physical therapy (PT) in restoring and maintaining patient mobility, function, and well-being, emphasizing the challenges posed by lack of supervision and self-correction during at-home exercises.
- Developed a new framework, PhysiQ, for continuous tracking and quantitative measurement of off-site exercise activity through passive sensory detection.
- Designed a novel multi-task spatiotemporal Siamese Neural Network within the PhysiQ framework to measure both the absolute quality of exercises through classification and the relative quality based on an individual's PT progress through similarity comparison.
- Implemented PhysiQ to digitize and evaluate exercises based on three different metrics: range of motions, stability, and repetition.
- Conducted data collection and annotation for 31 participants with varying levels of exercise quality to aid in the evaluation of PhysiQ.

- Showcased PhysiQ's ability to recognize subtle differences in exercises, operate with varying numbers of repetitions, and achieve a detection accuracy of 89.67% for levels of exercise quality, as well as an average R-squared correlation of 0.949 in similarity comparison.

Linking Anxiety to Passion (doi)   **Python, Excel**   **Sep 2020 – Jun 2021**
- *Supervised by Professor Christopher Bauman and Lily Yuxuan Zhu*
- Organized the data collection of judges 'rating sheets for 50+ new entrepreneurs from the New Venture Competition at the Paul Merage School of Business at the University of California, Irvine.
- Restructured the data with a new template for analysis to provide an accurate and clean dataset.
- Examined the usefulness and consistency of the dataset and re-categorized the data into new structures.

Unlocking creative potential: **Python, Excel**   **Jun 2020 – Jun 2021**
Reappraising emotional events
facilitates creativity for conventional
thinkers (doi)
- *Supervised by Professor Christopher Bauman and Lily Yuxuan Zhu*
- Scored and examined 300+ participants' novelty and usefulness in their solutions to address an issue related to bankruptcy due to mismanagement and poor-quality food in a cafeteria.
- Categorized ideas generated by participants to facilitate analysis of causal relationships among novelty, usefulness, and cognitive flexibility.
- Implemented a Python program to facilitate the process of categorizing participants to minimize the redundancy of the work and the discrepancy of the coding.

Cloudberry/Big Data Visualization   **Java, PostgresSQL, Scala**   **Apr 2019 – Jun 2019**
- *Supervised by Professor Chen Li*
- Implemented the web application to generate the TwitterAPI-referenced data using graph visualization and restructured the backend and frontend connectivity.
- Analyzed the underlying algorithm designs and ranked drawbacks and advantages of various data structures.
- Researched to minimize data representation for efficiency using bundling, clustering, incrementality, and tree cut.

EMPLOYMENT

Research Assistant   **Vanderbilt University**   **May 2022 – <u>Current</u>**
- Conducted research on activity recognition using deep learning methodologies, focusing on enhancing the quality assessment of exercises through Explainable Artificial Intelligence (XAI) techniques.
- Supervised and collaborated with a team of 4-5 undergraduate students on the development of a mobile application, primarily focusing on the application's data visualization and segmentation features, and research on human activities recognition (HAR) techniques.
- Worked closely with the team to promote an effective learning environment, fostering innovation and encouraging the application of theoretical concepts in a practical setting.

Teaching Assistant   **Vanderbilt University**   **Aug 2023 – <u>Current</u>**
- Assisted in teaching an intro to AI course and AI in Cyber Physical System (CPS) course in fall and spring semester.
- Presented works in human activity recognition (HAR) and SOTA method and work that are being utilized.
- Graded homework and assignments such as summary of papers and projects of AI in episodic or sequential with fully observable environments.
- Hosted at least 2 hours of office hours weekly to offer support to students in homework and understanding of the coursework.

Teaching Assistant   **Vanderbilt University**   **Aug 2021 – May 2022**
- Assisted in teaching an operating system course, which had approximately 100 students per semester, using the C programming language.
- Graded around 11 homework assignments each semester, ensuring a thorough understanding of each student's abilities and offering personalized feedback to enhance their learning experience.
- Hosted at least three hours of office hours per week to offer academic support to students, help with homework and provide clarification on course content.
- Refined course slides and materials to better aid students' understanding of operating system concepts and practices.
- Conducted surveys and interviews to better understand how to improve course materials and facilitate students' learning experiences.

Undergraduate Grader   **University of California, Irvine**   **Sep – Dec 2019, Mar – Jun 2020**

- Designed and developed extensive test cases for command-line programs, Bash-like shell, dynamic memory allocator, and client/server network programming in C.
- Collaborated with the professor and team of 2 graders to design C programming assignments that could be programmatically tested with the auto-grader.
- Assisted students 1-on-1 with debugging programs and understanding test case failures.

Information Services Intern   **St. Jude Children Research Hospital**   **Jun 2019 – Aug 2019**
- Developed Single Sign-On project using Agile & Waterfall development cycles and researched Active Directory Federation Service applications for authentication.
- Implemented idP-initiated SSO with Angular framework as frontend and Node.js as backend server to process SAML assertion from ADFS. Deployed application on Tomcat to test the Active Directory by using SecureAuth.
- Optimized the application with MIT-Licensed NPM plugin for SAML 2.0, samlify, to establish connectivity with Active Directory over the Node.js.

TEACHING EXPERIENCE

Teaching Assistant, Introduction to Artificial Intelligence   **Vanderbilt University**   **Aug 2022 – *Current***
- Supported approximately 40 students per semester, focusing on core AI concepts such as search algorithms, machine learning, reasoning, and neural networks.
- Organized and maintained teaching tools and resources, ensuring smooth course delivery and accessibility for students.
- Hosted weekly office hours to clarify complex topics, assist with assignments, and guide students on course projects.
- Graded assignments and projects, providing detailed and constructive feedback to enhance students' understanding of AI methodologies.
- Assisted in organizing and coordinating course materials and activities, collaborating with faculty to improve learning outcomes and student engagement.

Guest Lecturer, Cyber-Physical Systems Course   **Vanderbilt University**   **Aug. 2022, Mar. 2023, Nov. 2024**

- Delivered a comprehensive guest lecture on the topic of Cyber-Physical Systems, shedding light on the techniques and applications of time-series analysis, signal processing, activity recognition, and Explainable Artificial Intelligence (XAI).
- Guided students in understanding the complexities and methodologies related to integrating physical and computational processes, with a specific focus on how they apply to real-world systems and environments, such as wearable devices.
- Demonstrated the application of activity recognition methodologies and XAI within the context of cyber-physical systems, using practical examples to reinforce theoretical concepts.
- Engaged students through interactive discussions and Q&A sessions, fostering an environment that encouraged intellectual curiosity and critical thinking.

Teaching Assistant, Operating Systems   **Vanderbilt University**   **Aug 2021 – May 2022**
- Instructed and mentored approximately 100 students per semester, focusing on key aspects of operating systems such as cache management, processes, threads, and kernel operations using the C programming language.
- Hosted weekly office hours for three hours per session, providing academic support to students, clarifying course content, and offering assistance with homework.
- Conducted in-depth grading of 11 homework assignments per semester, evaluating each student's understanding of course materials and providing tailored feedback to enhance their learning and comprehension.
- Collaborated with other faculty members to refine course slides and materials, aiming to increase students' understanding and engagement with the course content.
- Undertook surveys and interviews to gather student feedback, using these insights to further improve course materials and optimize the learning experience.

LEADERSHIP AND SERVICE

Graduate Honor Council Panelist   **Vanderbilt University**   **July 2024**
- Acted as a panelist to understand and justify the accused student and his/her innocence towards Vanderbilt School Honor Codes.
- Reviewed the materials of the accused, student and accusers, instructors to capture the full story of the situation and discussed the potential violation of the honor code at graduate school level.

Volunteer, IEEE/ACM CHASE2024   **Wilmington, DE**   **June 2024**

- Worked around 10 hours in total for the period of 3 days at the conference; helped at the registration desk to guide conference participants and to distribute conference materials.
- Communicated and introduced the general guideline and schedules; organized the poster sessions for clarification of locations, materials gathering, and assistance of troubleshooting.

Volunteer, Graduate Student   **Vanderbilt University**   **Mar 2024**
Recruitment Day
- Toured the new student body to different departments and building on campus at Vanderbilt University.
- Communicated and introduced the research works at Institute for Software Integrated Systems at Vanderbilt University.
- Discussed the experiences and future directions with faculties and new recruits.

Mentor, Students Projects   **Vanderbilt University**   **August 2021 – Current**
- Mentored eight undergraduate students on various projects spanning iOS app development, Unity visualization, research brainstorming, and literature review.
- Provided guidance and support to students, helping them develop their technical skills and research abilities.
- Facilitated project discussions and brainstorming sessions, fostering a collaborative and creative environment.
- Monitored project progress, provided feedback, and encouraged independent thinking and problem-solving.
- Mentored an undergraduate student in 2024 on research in continual learning, focusing on a novel method to preserve representational space effectively. This work was presented at the Vanderbilt Undergraduate Research Fair (2024) and earned recognition through a poster award.

Volunteer   **Nashville, TN**   **June 26–29, 2023**
- Provided volunteer support during the SmartComp 2023 conference for four days.
- Organized posters, provided guidance to presenters, and assisted with running errands.
- Assisted in organizing presentations and panels, ensuring smooth transitions and timely schedules.
- Collaborated with the conference team to create a positive and engaging environment for attendees.
- Contributed to the overall success of the conference by fulfilling various volunteer responsibilities.

TECHNICAL EXPERIENCE

Academic Projects
- **Principles of Data Management (Database Management System):** Collaborated on a project in C/C++ to implement paged file (PF) and record-based file (RBF) management systems. Upgraded relation manager (RM) designs to store catalog information by columns, with hidden metadata.
- **Process and Resource Manager:** Implemented Python data structures to manage processes and resources, optimizing process states and supporting multi-unit resource usage.
- **File System:** Designed a Java file system using an emulated disk, optimized with a directory using fixed index structures as file descriptors.
- **Simple Bash-like Shell:** Created a C-based shell capable of handling simple and complex commands, with multi-piping, redirection, background process, and signal handling functionalities.
- **Search Engine:** Implemented a search engine in Python that ranks HTML data's importance and uses term frequency-inverse document frequency (tf-idf) and cosine similarity for search functionality.
- **Online Movies Store Web Application:** Collaborated on building a cloud-based server and web application using Java, MySQL, HTML, CSS, and Maven. Optimized usability with Tomcat and MySQL replication, connection pooling, and micro-services architecture.
- **Opioid Hackathon (AS FINAL NOMINEE):** Worked as an iOS developer on a Swift-based social media application designed to treat patients through a supportive community, strong interaction among patients, family members, and specialists.

Personal Projects
- **B+ Tree for Database Management:** Developed a B+ tree data structure for efficient database management. This project involved a deep understanding of tree-based data structures and algorithm optimization. The B+ tree data structure allows for efficient insertion, deletion, and search operations, significantly improving the database's performance.
- **AI Stock Watch Bot:** Built an AI bot for monitoring stock market trends and making data-driven predictions. The bot uses machine learning techniques to analyze historical stock data and generate forecasts. It aids in making informed investment decisions by providing insights into potential market trends. The project involved implementing machine learning algorithms, data preprocessing, and working with financial data APIs.