Tianyi Wu
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Educational Background

Xi'an Jiaotong-Liverpool University (XJTLU), Suzhou, China **Sept. 2022-Jul. 2026**

- **Degree:** Bachelor's in Information and Computing Science | **GPA:** 4.0/4.0
- **Coursework Highlights:** Computer Systems, Computer Networks, Computer Graphics, Software Engineering, Introduction to Databases, Discrete Mathematics and Statistics, Java Programming, Data Structures, Algorithmic Foundations and Problem Solving, Artificial Intelligence, etc.
- **Honors:** 2023-2024 Xi'an Jiaotong-Liverpool University Undergraduate Academic Scholarship (Top 10%)

UC Los Angeles, Online: Electrical Engineering - IoT and UAV Array Network Communication System Design **Nov. 2024**

Imperial College London, Online: Machine Learning in Biomedical Sciences and Bioengineering **Mar. 2024**

UC Berkeley, Online (Self-learning): CS61B: Data Structures and Algorithms **Apr. 2023**

Publication

- Wu, T., Huang, Y., Craig, P., & Purwanto, E (2024). **EmoMA-Net: A Novel Model for Emotion Recognition Using Hybrid Multimodal Neural Networks in Adaptive Educational Systems**. In Proceedings of The 7th International Conference on Big Data and Education (ICBDE 2024), Paper No. CD1068, September 24-26, 2024, Trinity College, University of Oxford, UK. **(Published)**
- Wu, T., Huang, Y., & Purwanto, E. **M3RNet: Enhancing Multimodal Emotion Recognition with Memory-Augmented Transformers on Physiological, Behavioral, and Video Modalities.** In Proceedings of International Conference on Computer Vision (ICCV 2025). **(Awaiting Publication Results)**
- Wu, T., Huang, Y., Purwanto, E., Juwono, F., & Tang, F. (2025). Enhancing Multilingual Emotion Classification with Attention Mechanism for Transnational Education. In Proceedings of the 2025 International Conference on Artificial Intelligence and Education (ICAIE 2025), May 14-16, 2025, Suzhou, China. **(Published)**
- Purwanto, E., Wu, T., & Huang, Y. **Phy-FusionNet: A Memory-Augmented Transformer for Multimodal Emotion Recognition with Periodicity and Contextual Attention.** In Proceedings of IEEE Transactions on Affective Computing. **(Awaiting Publication Results)**

Research Program

First Author, **M3RNet: Enhancing Multimodal Emotion Recognition with Memory-Augmented Transformers on Physiological, Behavioral, and Video Modalities** (*Advisor: Dr. Erick Purwanto, XJTLU*) **Nov. 2024**

Summary: M3RNet advances multimodal emotion recognition by integrating a memory-augmented transformer, the Memory Stream, to improve long-term feature retention. This system, utilizing the TMBL framework, enables sophisticated multimodal fusion that boosts accuracy across datasets like PPB-Emo and CL-Drive.

- Introduced M3RNet, featuring the Memory Stream, an innovative component inspired by SAM2's memory mechanisms, which was specifically designed to enhance the transformer's ability to maintain long-term feature memory, crucial for capturing detailed emotional cues in multimodal data.
- Enhanced the transformer architecture with the Memory Stream to improve long-term dependency handling, which enhanced accuracy and stability across diverse emotional datasets.
- Implemented TMBL, a transformer-based multimodal binding learning framework, to fuse physiological and video data, which boosted the model's effectiveness in managing cross-modal interactions.
- Optimized and validated M3RNet's performance on multiple datasets, achieving over 9.15% improvement in accuracy on the PPB-Emo dataset and surpassing baseline models by 10.09% on the CL-Drive dataset, demonstrating its robustness and adaptability in real-world applications.

First Author, **EmoMA-Net: A Novel Model for Emotion Recognition Using Hybrid Multimodal Neural Networks in Adaptive Educational Systems** (*Advisor: Dr. Erick Purwanto, XJTLU*) **July 2024**

Summary: The project developed the EmoMA-Net, a novel multimodal neural network for real-time emotion recognition in educational settings. By utilizing physiological data from wearable sensors, this model will enhance adaptive learning environments by providing educators with immediate feedback on student stress levels.

- Designed the multimodal neural network framework of EmoMA-Net, integrating advanced machine learning techniques such as Long Short-Term Memory (LSTM) systems and Convolutional Neural Networks (CNNs) to capture both temporal and spatial features of physiological data effectively.
- Incorporated the Convolutional Block Attention Module (CBAM), optimizing feature extraction by focusing on relevant features and improving model accuracy and reliability; This mechanism addressed the limitations of traditional attention systems by enhancing both channel-wise and spatial attention within the network.
- Utilized LSTM to enhance the temporal analysis capabilities of the model, allowing for better handling of time-series data and overcoming challenges such as gradient vanishing and information loss typically encountered in standard Recurrent Neural Networks (RNNs).
- Validated and tested the model using the WESAD dataset, achieving a high prediction accuracy of up to 99.66%, which demonstrated the model's superior performance and adaptability in emotion recognition tasks, highlighting its potential effectiveness in real-time, high-stakes educational environments.

Project Experience

Daily Reading Tracker Design **Apr. 2025**

- Developed a secure and efficient reading tracker system with a robust user authentication module, realizing key features such as user registration, email verification, password encryption, and JWT-based session management; Refined the role assignment mechanism to enhance access control and implemented password recovery functionality.
- Enhanced the reading log management module by enabling multi-criteria search and filtering for faster data access; Built the front end with HTML5, CSS3, and JavaScript to support dynamic interactions, while employing Spring Boot to deliver high-performance CRUD APIs in the back end, integrated front-end and back-end data validation using HTML5 constraints and back-end DTO annotations, ensured greater data integrity.
- Modularized the back-end services with a clear hierarchical architecture and clearly defined front-end and back-end component responsibilities, utilized a security filter using Spring Security to enhance operational rights management.
- Carried out comprehensive unit and integration tests, using Mockito and Spring Boot Test to cover core functionalities and exception handling across key modules; Conducted load testing to verify system stability and performance under high concurrent user access.

Kaggle - RSNA 2024 Lumbar Spine Degenerative Classification **Sept. 2024**

- Developed a multi-stage deep learning model based on the ResNet-UNet framework designed to detect and classify degenerative lumbar spine conditions from MRI images; Utilized advanced techniques such as principal component analysis for feature extraction and dimensionality reduction, to ensure high-quality image preprocessing with methods like histogram equalization and Gaussian filtering.
- Implemented a sophisticated model structure, integrating ResNet as the encoder to extract deep features and capture multi-scale global context, and UNet for decoding with symmetrical skip connections to preserve high-resolution features and semantic context; Applied multi-task learning strategies at the classifier head to predict severity levels of various spinal conditions, which enhanced the model's diagnostic accuracy.
- Optimized classification and inference processes using weighted binary cross-entropy loss to handle class imbalance and employed temperature scaling and post-processing techniques to improve the stability of prediction probabilities; The ensemble methods and soft voting mechanisms further boosted the model's robustness during inference.

Student Data Analysis **Mar. 2024-Jun. 2024**

- Performed preprocessing on student data and principal component analysis (PCA) for feature extraction and dimensionality reduction, analyzed the contribution of each feature in project classification, and assessed their impact on the performance of classification models.
- Classified student projects using decision trees, random forests, support vector machines, and Naive Bayes algorithms, evaluated the performance of different algorithms on project classification tasks, and built an ensemble classifier to compare feature selection methods associated with different classifiers.
- Fitted feature distributions using Gaussian Mixture Models, k-means algorithm, and hierarchical clustering algorithms, sought methods that reflect the distribution of project information, and assessed the degree of association between clustering results and student projects, completing the project report.

Regression Analysis and Deep Learning Applications **Jan. 2024-May 2024**

- Implemented regression algorithms and multivariate models; Optimized linear and logistic regression using gradient descent and performed data visualization to enhance model parameter tuning across variables.
- Utilized Convolutional Neural Networks (CNNs) and Multi-Layer Perceptrons (MLPs) to classify the MNIST dataset, and developed Recurrent Neural Network (RNN) models using PyTorch for text classification tasks, optimizing with Stochastic Gradient Descent (SGD) and Negative Log Likelihood Loss (NLLLoss).
- Built sequence-to-sequence models to assess translation accuracy, alongside constructing a CNN for image classification tasks on MNIST, improved model generalization through data augmentation and regularization techniques; Designed and implemented saving and loading functionalities for models, which facilitated reuse and deployment in various applications.

Summer Undergraduate Research Fellow, **MetaTeddy: Interactive Reality Modeling Interface for 3D Freeform Design** **Jun. 2023-Sept. 2023**

- Utilized Google Scholar, IEEE Xplore, and ACM Digital Library to gather literature on relevant implementation principles and specific technical information for the project's implementation and innovation.
- Developed a 2D interactive interface using Unity based on the Teddy system framework; Implemented precise cutting operations using the Computational Geometry Algorithms Library (CGAL) and partitioning algorithms, and enhanced model manipulation with the TouchScript plugin for easy rotation by users.
- Integrated Extended Reality (XR) technologies using Microsoft Hololens 2 as the visual operating device for users; Combined MetaTeddy with AR headsets through the Unity engine and AR Foundation plugin, and used Node.js with the Socket.io library to facilitate network connections and process monitoring between the server side and AR glasses, enabling users to transform models from a 2D tablet interface into 3D visualizations.

Additional Information

- **Languages:** Chinese (native), English (fluent, over 2 years in an all-English teaching environment)
- **Programming:** Python (Pandas, Numpy, Scikit-learn, Matplotlib, Seaborn, TensorFlow, PyTorch, pytest), Java (JUnit, Spring Boot), SQL (MySQL, Snowflake), R, Matlab, Git
- **Interests:** Piano (Level 10 certification from Shanghai Conservatory of Music), Street Dance (Level 4 certification from China Street Dance Association), Badminton, Movies
- **Community Activity:** Member, Xi'an Jiaotong-Liverpool University Psychology Association (PSYA)