# Jianhong Tu

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## EDUCATION

**Bachelor of Science in Data Science** — St. Louis, MO
Washington University in St. Louis (**GPA**: 4.0/4.0) — Expected May 2025

## RESEARCH EXPERIENCE

**Computer Vision Course Project**
*Advisor: Nathan Jacobs (Professor)* — Feb. 2024 – Jun. 2024
Exploring Open-Vocabulary Segmentation with Vision-Language Model

- Designed a CLIP-based vision-language model for multi-label classification and a U-shaped Transformer-based image segmentation model to end-to-end predict a sequence of binary masks and soft class labels.
- Performed large-scale training experiments and ablation studies on the COCO-stuff dataset using PyTorch and the Detectron2 framework.
- Evaluated the model on five benchmarks and showed competitive performance compared to previous methods.

**WashU NLP Lab**
*Advisor: Chenguang Wang (Assistant Professor)* — Nov. 2023 – Present
Advancing Bimodal Zero-Shot Question Answering in Multimodal Large Language Models

- Proposed a pipeline to synthesize high-quality vision instruction-tuning data by one-shot prompting large open-source language models with GPT-4V examples.
- Researched vision and language instruction-tuning in LLaMA2-based multimodal LLMs and showed that the zero-shot abilities can be efficiently transferred across modality on downstream language and vision tasks.
- Conducted experiments by scaling data size and language-to-vision data ratio, and analyzed model's attention distribution and instruction diversity.

**BioSURF Program**
*Advisor: James McGregor (Post-doctoral Researcher)* — May 2023 – Sept. 2023
Pertained Convolutional Network with Attention for Sleep Staging in Mouse Model

- Proposed a CNN-Transformer classifier trained in a two-stage manner, which outperforms single human expert (>95%) in classifying animal sleep stages into 3 classes based on single-channel neural recording.
- Conducted statistical analysis on the correlation between sleep deficiency and tauopathy using linear models.

**Hengen Lab**
*Advisor: Aidan Schneider (Senior Doctoral Researcher)* — Jan. 2024 - Present
Keypoint-based Action Recognition Model

- Trained Yolo-v8 and DeepLabCut models on mouse hunting videos to track the 2D position of various mouse body parts, environment objects, and the prey.
- Designed Mixture-of-Expert, Transformer, and Temporal Convolution models to classify keypoints input into 12 action states with up to 90% accuracy.

*Advisor: Keith Hengen (Assistant Professor)* — May 2022 – May 2023
Neural Data Preprocessing and Analysis

- Compiled over 1000 hours of neural recordings from 50 lab animals, storing experiment information in a SQL database.
- Built an automatic software to asynchronously apply signal processing, neuron clustering, and spectral analysis.
- Used ANOVA, Linear Mixed-Effect Models, and statistical test to analyze the impact of natural factors in the mouse model of Alzheimer's disease.

## Other Selected Projects

**Deep Graph Representation Learning in Soccer Pass Network**

- Designed a neural network with an embedding layer and contrastive loss to learn a low-dimensional vector representation for node clustering and algebraic semantic analogy analysis on a soccer network.

**Information Retrieval Neural Network for Question-Answering in ESL education**

- Built a language model ensemble to predict the appropriate response in the MultiWOZ dataset for a query input as Chatbot assistant for English acquisition.

**Predictive Model Building for a Robot Control Problem**

- Built a regression pipeline to predict the evaluation function of a robot control system by engineering features with principal component analysis, feature creation with Gaussian Mixture Models, and performing cross-validation with Gradient Boosting tree, Kernel ridge regression, and Support vector regression.

## Work Experience

**Co-Founder of an AI Education Start-Up** June 2023 – Present

- Created the backend of a ChatGPT-powered online application for standardized exam education with custom prompts and SQL caching.

**Software Developer at an Independent Game Studio** Apr. 2022 – Sept. 2022

- Built the prototype of a 3D role-play game involving combat against AI-controlled agents and interactive map exploration using the Unity engine and C#.
- Created a celluloid shader and customizable rendering pipelines using HLSL language optimized for the Windows environment.

## Teaching Experience

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| Undergraduate Lab Mentor, Research Experience for Undergraduates Program | June 2024 – Present |
| Teaching Assistant, CSE527 Natural Language Processing | Jan. 2024 – May 2024 |
| Teaching Assistant, CSE561 Large Language Models | Jan. 2024 – May 2024 |
| Teaching Assistant, CSE131 Introduction to Computer Science | Sept. 2021 – May 2022 |

## Publications & Presentations

**Co-author** on the paper "Failure in a population: tauopathy disrupts homeostatic set-points in emergent dynamics despite stability in the constituent neurons." *Neuron, Cell* (Accepted on Aug. 10, 2024)

**First Author** on the paper "Cross-Modality Generalization of Zero-Shot Ability in Multimodal Large Language Models." (Work in Progress)

**Main presenter** on the project "A Machine-learning based Sleep Analysis of Mouse Model of Alzheimer's Disease" at WashU Undergraduate Symposium.

**Presenter** on the project "Efficient Cross-Modal Reasoning Transfer in Vision Language Model" at WashU Student Research Internship Program.

## Honors & Awards

**Antoinette Dames Award**, Washington University in St. Louis

**Dean's List** (All Semesters), Washington University in St. Louis

## Skills

**Programming**: Python, C++, Java, AMPL, SQL, R

**Deep Learning**: TensorFlow, PyTorch, Detectron2, lm-eval; **Statistics**: ANOVA, Liner Mixed-Effect Model