Zixuan Song

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EDUCATION

Washington University in St. Louis May. 2026 St. Louis, MO
Bachelor of Science in Computer Science and Mathematics Dean's List (all semesters)
Bachelor of Arts in Biology (Neuroscience) Major GPA 3.79/4.00

RESEARCH & INTERNSHIP

Data Analysis and Animal Behavioral Studies in Complex Settings St. Louis, MO
Research Assistant; The Hengen Lab (PI: Prof. Keith Hengen) Jan. 2024 – Ongoing

- Developed an automated behavior-tracking pipeline using DeepLabCut and YOLO; deployed on an IBM Spectrum LSF cluster to parallelize processing and reduce analysis time from several weeks to 3 days.
- Designed a labeling, quality check, and retraining workflow that automates task assignment, integrates new annotations for CV model updates, and reallocates workload (Kubernetes distributed training/validation).
- Implemented and evaluated behavioral classification models (MLE baselines, XGBoost, Transformer, Mixture-of-Experts), using Hyperopt for large-scale hyperparameter optimization and comparative model selection.
- Created a YOLO-based cockroach tracking system with newly annotated datasets, improving detection robustness under occlusion and variable lighting conditions.
- Designed an unsupervised discovery pipeline (t-SNE/UMAP) to identify and characterize latent clusters of hunting strategies from high-dimensional behavioral features.
- Validated behavioral findings using statistical methods (LMM, ANOVA, Tukey HSD)
- Improved experimental hardware/software reliability for sleep-deprivation paradigms, eliminating recurring system failures through iterative redesign and troubleshooting.
- Contributed to experimental preparation supporting in vivo studies (tetrode construction, animal monitoring, and standardized pre-/post-experiment handling).
- Built visualization and reporting tools (including an interactive website) for internal analysis and conference presentation; presented results at NEXTEN 2024.
- Currently leading manuscript preparation on computational characterization of adaptive hunting behavior.

Algorithm Design and Application of the Brain Criticality Hypothesis St. Louis, MO
Research Assistant; The Hengen Lab (PI: Prof. Keith Hengen) Jan. 2024 – Ongoing

- Analyzed neural recordings from Alzheimer's disease mouse models under the Brain Criticality Hypothesis using DCC, d_2, and d_β metrics; examined relationships with experimental covariates (e.g., sleep deprivation).
- Contributed to development and optimization of the lab's d_2 Python implementation, correcting numerical edge cases and improving reliability on previously untested regimes.
- Designed and benchmarked a d_β algorithm for criticality analysis; developed validation procedures for metric computation.
- Achieved $>90\%$ accuracy in early disease-onset prediction using criticality-derived features while reducing execution time by $>99\%$ through algorithmic and implementation-level optimization.

Tencent Quantum Lab Shenzhen, China
Research Intern; Teaching Assistant Sep. 2022 – Sep. 2023
Code: tencent-quantum-lab/tensorcircuit

- Implemented quantum analogues of classical ML models within TensorCircuit (e.g., ensemble-style methods).
- Debugged and ported the codebase for macOS and Apple Silicon, including Metal API support.
- Investigated error-mitigation methods for noisy quantum hardware (e.g., HAMMER).
- Delivered lectures and designed assignments on quantum machine learning and quantum algorithm design.

TECHNICAL SKILLS

Programming: Python, R, Java
Machine Learning: DeepLabCut, YOLO; transformers, ensemble methods, kernel methods
Scientific Computing: PyTorch, TensorFlow, TensorCircuit
Statistics: linear mixed-effects models (LMM), ANOVA, hypothesis testing
Neuroscience/Behavior: in vivo electrophysiology (voltage clamp), animal behavioral assays, animal handling
Molecular/Wet Lab: PCR, gel electrophoresis, DNA sequencing, cell/bacterial culture
Languages: Mandarin (fluent), English

PROJECTS

WashU AI Hackathon St. Louis, MO
Skandalaris Center & Hack WashU Oct. 2025
Live Demo: ai.marksong.tech; *Description: marksong.tech/school/washu/canvas/*
- Built a tool-using (ReAct-style) AI agent with student-scoped Canvas LMS access.
- Integrated vector-store semantic search over course files for retrieval-grounded responses.
- Developed LLM model routing and implemented an asynchronous backend integrating 22 Canvas LMS tools for content retrieval and 4 vector store tools for Retrieval-Augmented Generation (RAG) uploads.
- Implemented an asynchronous server architecture with real-time updates via Secure WebSockets (WSS).

Robustness of Information Aggregation in LMSR-Based Prediction Markets St. Louis, MO
CSE 5106 Multi-Agent Systems Jan. 2026 – Ongoing
- Implemented a lightweight LMSR market maker and end-to-end prediction-market simulator in Python (NumPy), producing reproducible run artifacts (CSV/JSON) and plots (Matplotlib).
- Built a library of heterogeneous trading agents, including informed (Bayesian), risk-averse, noise, momentum/mean-reversion, and multiple adversarial strategies (e.g., budgeted, adaptive, pump-and-dump).
- Designed robustness and convergence metrics for information aggregation, including KL divergence / total-variation distance, convergence time (rolling threshold), and recovery time after adversarial trading.
- Added market defenses and constraints (transaction fees, order-size/position caps, cooldowns, adversary active windows) and enforced solvency-style risk controls to prevent pathological trading.
- Developed an experiment framework with YAML-configured scenarios, parameter sweeps, and multi-seed evaluation with suite-level summaries and comparison tables (CSV/Markdown).
- Wrote sanity tests with `pytest` and structured the codebase for fast iteration and scalable batch runs.

Surgical Techniques, In Vivo Neural Recording, Experimental Design, Data Analysis, and Scientific Writing (Biol 404 Neurophysiology Lab) St. Louis, MO
Supervised by Dr. Mitchell Kundel Aug. 2024 – Dec. 2024
- Designed experiments, hypotheses, and evaluation criteria; analyzed electrophysiological measurements.
- Performed mouse tracheostomy and cochlear electrode implantation; recorded neural activity under anesthesia.
- Isolated bullfrog sciatic nerve via dissection to enable electrophysiological recording and analysis.
- Conducted crayfish tail ablation and recorded neuromuscular activity; analyzed resulting traces.
- Generated waveform visualizations and quantitative summaries
- Co-authored three laboratory manuscripts on findings and future directions.
- Used surgical technique and scientific writing through repeated procedures and literature-based investigation.

PUBLICATIONS

Li, S., Peng, X., Pang, R., Li, L., **Song, Z.**, & Ye, H. Information preference and information supply efficiency evaluation before, during, and after an earthquake: Evidence from Songyuan, China. *International Journal of Environmental Research and Public Health* **18**, 13070 (2021). doi:10.3390/ijerph182413070

Schneider, A.*, Chitalia, J.*, **Song, Z. (M.)***, & Hengen, K. Hunting in the Urban Jungle: Unveiling Complex Predatory Behaviors in Mice Through Ecologically-Inspired Environments. Poster presented at NEXTEN 2024, St. Louis, MO, September 16, 2024.

*Denotes co-first authorship

AWARDS

Summer Undergraduate Research Guided Experience (SURGE) St. Louis, MO
WashU Office of Undergraduate Research (OUR) May 2025 – Ongoing
- Selected for SURGE with a $5,400 research stipend and structured mentorship/training.
- Presented at the WashU Fall Undergraduate Research Symposium (2025).
- One of 172 awardees in the 2025 cohort.

WashU AI Hackathon St. Louis, MO
Skandalaris Center & Hack WashU Oct. 2025
Top 8 team out of 350+ teams; $500 prize.