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## EDUCATION

### Washington University in St. Louis

*Bachelor of Science in Computer Science and Mathematics*  
*Bachelor of Arts in Biology (Neuroscience)*

May. 2026

St. Louis, MO  
Dean's List (all semesters)  
Major GPA 3.79/4.00

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## RESEARCH & INTERNSHIP

### Data Analysis and Animal Behavioral Studies in Complex Settings

*Research Assistant; The Hengen Lab (PI: Prof. Keith Hengen)*

St. Louis, MO  
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

*Research Assistant; The Hengen Lab (PI: Prof. Keith Hengen)*

St. Louis, MO  
Jan. 2024 – Ongoing

- Analyzed neural recordings from Alzheimer's disease mouse models under the Brain Criticality Hypothesis using DCC,  $d_2$ , and  $d_\beta$  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  $d_\beta$  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

*Research Intern; Teaching Assistant*

Shenzhen, China  
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.

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## 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

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### 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

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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

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### 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.