SHUTIAN LIANG

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Education

Peking University, Beijing, China *Sep. 2020 - July 2024*
B.S in Psychology, GPA: 3.75 / 4.00(before the last semester 3.64 in total) Rank: 3/56

Working Experience

Neural Information Process Lab, Peking University, Beijing, China *Sep. 2024-Aug.2025*
Research Assistant | Principal investigator: Prof. Si Wu, Peking University

Research Experience

Diffusion process to video diffusion models

Advisor: Prof. Si Wu, McGovern Institute for Brain Research, Peking University *Jan. 2024 – present*

- Inspired by the Ornstein-Uhlenbeck process, I incorporate frame-to-frame correlated noises into video diffusion models. By adjusting the diffusion and drift parameters, we can control both the decay rate of the diffusion process and the corresponding standard deviations of each marginal distribution.
- Experiments with a vanilla U-Net show that these correlated noises can enhance the consistency between subjects and backgrounds during generation, and even sampling with Ornstein-Uhlenbeck noises yields better performance.
- Currently, I am fine-tuning a pre-trained image diffusion model and randomly initializing the temporal attention layers to compare its performance with existing video diffusion models (e.g., PYOCO).

Build up natural travelling wave machines to encode past events

Advisor: Prof. Si Wu, McGovern Institute for Brain Research, Peking University *Oct. 2024 – Dec. 2024*

- Theoretically prove that artificially travelling wave RNN captures past information is equivalent to solving first-order linear equations.
- Using a two-dimensional continuous attractor neural network(CANN) dynamics with spike frequency adaptation capable of exhibiting travelling waves in neurons to perform hidden state updates in RNN.
- Current results show that the biological plausible CANN-RNN can perform memory tasks and outperforms identity RNNs.

Generalization and memorization in generative models

Advisor: Prof. Si Wu, McGovern Institute for Brain Research, Peking University *Sep. 2024 – Oct. 2024*

- We investigate the functional properties of specific deep generative models (Energy-Based Models, Variational Autoencoders, and Diffusion Models) to understand the origins of their generalization abilities. I analyze the Hessian matrix of the model functions and find that many local minima of the curves correspond to the same images.
- Unfortunately, due to a lack of analytical methods, we cannot derive sufficient additional information, and this project has been temporarily put on hold.

Evaluating the cognitive functions between human and LLM

Advisor: Prof. Si Wu, McGovern Institute for Brain Research, Peking University *May. 2024 - Jun. 2024*

- Conduct the mentioned psychology experiment on GPT-4o to investigate the differences in decision traits between humans and LLMs
- After comparing various cognitive models, I proposed a novel local search model and demonstrated that it provides a better fit for GPT-4o.

- My experiments demonstrate that, compared to humans, LLMs are more inclined to perform local search and currently lack the ability to learn functions in complex physical spaces.

How working memory influents human decision making in explore-exploit dilemma

Advisor: Prof. Hang Zhang, McGovern Institute for Brain Research, Peking University *Sep. 2022 - Sep. 2023*

- Adapted a psychology experiment (code by MATLAB psychotoolbox) to investigate whether cognition load influences exploration and exploitation behavior in complex grid environment.
- Using maximum likelihood estimation with Gaussian process regression and upper confidence bound sampling for quantitative estimation of subjects' behavior.
- Results show that participants exhibit increased decision noise (random exploration) under higher cognitive load, while their directed information seeking remains unchanged.

Cognitive phenotype shifts in risk-taking: interplay of non-suicidal self-injury behaviors and intensified depression

Advisor: Prof. Hang Zhang, McGovern Institute for Brain Research, Peking University *Apr. 2022 - Jun. 2023*

- Participated in coding and modifying online experimental procedures (Accomplished by Psychojs).
- Collected data from experiments and questionnaires.

Teaching Experience

Psychological Statistics I

Teaching Assistant |Instructor: Prof. Jian Li, Peking University *Sep. 2023 - Dec. 2023*

- Designed lab materials and taught a lab course on basic statistics theory and conducting fundamental statistical inference by R.
- Prepared, assigned and graded weekly course works, you can find materials here.

Introduction to Cognitive Modeling

Teaching Assistant |Instructor: Prof. Hang Zhang, Peking University *Feb. 2025 - June. 2025*

- Designed lab materials on implementing parameter fitting using MLE or Bayesian Inference(Pymc)
- Prepared, assigned and graded weekly course works.

Publications

Paper

Yi-Long Lu, Yuqi Ge, Mingzhu Li, **Shutian Liang**, Xiaoxi Zhang, Yupeng Sui, Lei Yang, Xueni Li, Yuyanan Zhang, Weihua Yue, Hang Zhang, Hao Yan,Cognitive Phenotype Shifts in Risk Taking: Interplay of Nonsuicidal Self-Injury Behaviors and Intensified Depression,Biological Psychiatry: Cognitive Neuroscience and Neuroimaging,2024

Awards and scholarships

- Zhang Wenjin Scholarship, Peking University *Oct. 2021*
- Second Honor Prize, Peking University *Oct. 2022*
- Third Honor Prize, Peking University *Oct. 2023*
- QuanZheng Research Funding, Peking University *Apr. 2023*

Technical Skills

- **Programming**: PyTorch, MATLAB, PsychotoolBox, R; comprehend JavaScript, HTML/CSS
- **Mathematica**: Calculus, Linear Algebra, Probability statistics, Stochastic Analysis, Numerical Methods, Information Theory, Convex Analysis
- **Artificial intelligence:** Deep Learning, Reinforcement Learning, Machine Learning,