Yixiang Dai

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Education

University of Michigan Ann Arbor **Sep. 2023 – Now**
Bachelor of Science in Computer Science GPA: 3.9/4.0 *Ann Arbor, Michigan*

Shanghai Jiao Tong University **Sep. 2021 – Jul. 2023**
Bachelor of Science in Electrical and Computer Engineering GPA: 3.8/4.0 Top 10% *ShangHai, China*

Internship

Pixverse **May 2024 – Aug 2024**

- **Pretraining of Video and Image Generation Model Based on AutoRegressive Models:** Clear understanding of the differences between diffusion models, autoregressive models, and masked models. Created a codebase for masked generative models and various types of autoregressive models, ranging from LLaMA-based to VAR-based. Trained VAR-based image and video generation models, achieving speed that is six times faster than diffusion models.
- **New Training Strategy for VAR Training:** Developed a new multiscale VQVAE training-free method that does not rely on the unstable training of the original multiscale approach, achieving comparable results. This method can help utilize more open-source VQVAEs at higher resolutions.

Projects

Diffusion implementation of Google Emoji Kitchen **March 2023 – July 2023**

- **Inpainting + LoRA:** Currently proposed an Emoji fusion method based on inpainting and LoRA. LoRA effectively preserves the semantic structural information of the reference image while using inpainting with masking to replace the areas that need modification. This approach reduces labor costs and achieves favorable results compared to other methods.
- **Interpolation:** Construct a creative interpolation loss in the latent space that yields both creative and realistic results and combined the semantic information of two different Emojis
- https://github.com/daiyixiang666/Emoji-Kitchen.

Zero Shot Method for Style transfer using Diffusion Model | *Pytorch, Generative Model* **Sep 2023 - Dec 2023**

- **Innovative Zero-Training Style Transfer Method:** Proposed a novel style transfer method that requires no model training, significantly simplifying the entire process. This allows users to apply the method directly in real-world scenarios, saving a substantial amount of time and computational resources. The method generates images containing both style and content without needing additional training for a pretrained diffusion model.
- **More Flexible and Diverse Control:** Additional controls introduced through interpolation between style and content, guided by gradient descent, provide an ingenious way to balance content and style.
- **Excellent Oil Painting Style Transfer Results:** The method performs exceptionally well in transferring oil painting styles, achieving outstanding results by preserving the original content while seamlessly integrating the target style's features, offering a fresh visual experience.
- https://github.com/daiyixiang666/Styler-Transfer/tree/master.

Reaserch Experience

Understanding Gaussian Structures in Diffusion Model **Jan 2024 – May 2024**
Neurips 2024 *The University of Michigan*

- **Investigated the Inductive Bias towards Gaussian Structures in Diffusion Models:** Demonstrating that linear approximations of nonlinear diffusion denoisers align with the optimal denoisers of a multivariate Gaussian distribution defined by the empirical mean and covariance of training data.
- **Analyzed Connection between Gaussian Structures and Model Capacity:** Revealing that smaller models exhibit a stronger inductive bias towards capturing Gaussian structures, while larger overparameterized models may memorize training data as training progresses. Proposed early stopping as a strategy to enhance generalization in these models.
- **Generalizability of Diffusion Model Results from Inductive Bias:** The generalizability of diffusion comes from learning the Gaussian structures of dataset. We showing this by traning two model on two non-overlappind datasets with similar empirical covariances and means and the diffusion generate similar image and also similar to Gaussian model

Brain-like Models and Human Vision-Based Deep Learning **March 2023 – July 2023**

Innovation and Entrepreneurship Project *Shanghai Jiao Tong University*

- **Comprehensive Study of Brain-Inspired Neural Network Models:** Conducted an extensive study on brain-inspired neural network models, focusing on the complex mechanisms of human vision. By analyzing the workings of the human visual system, explored its potential applications in the field of computer vision.
- **Development of Innovative Brain-Like Neural Models:** Developed an innovative brain-like neural model aimed at improving the accuracy of image classification. This model incorporates insights from cognitive science and psychology, integrating the cognitive mechanisms of the human brain into the neural network. Utilizing diffusion-based img-to-img techniques enhanced recognition robustness, achieving a 0.5% increase in image classification accuracy based on VGG-16, thereby improving performance on image classification tasks.
- **Integration of Multimodal Neuroimaging Data:** Integrated multimodal neuroimaging data, including fMRI and EEG data, to enhance deep learning algorithms. Reproduced a multimodal study inspired by CLIP involving EEG and images, gaining insights into the limitations of EEG data and the significance of data distribution for neural network inputs.

Artificial Intelligence Security Count **March 2022 – July 2022**

Student participate in Reaserch program *Shanghai Jiao Tong University*

- **Deep Learning Model Construction and Adversarial Sample Generation:** A complex deep learning model was built using PyTorch, focusing on the generation of adversarial samples.
- **Adversarial Attack Framework Analysis and Model Evaluation:** Advanced adversarial attack frameworks, including $C\&W$ attacks, DeepFool, and PerC-AL, were thoroughly studied and reproduced. Through the analysis of these attack frameworks, the model's performance and differences were evaluated, providing important references for further enhancing system security.
- **Optimization of Attack Speed with Cross-Iteration Method:** The cross-iteration method was applied to optimize $C\&W$ attacks, significantly improving the attack speed—over 10 times faster than the original algorithm—thereby allowing for more effective evaluation of the model's security and stability. By continuously optimizing attack methods, the practicality and feasibility of adversarial attacks were strengthened.

Technical Skills

Languages: Python, C, C++,MATLAB
Developer Tools: VS Code, Pytorch
Technologies/Frameworks: Linux, Git
Skills: Adversarial Examples, Multi-model, Diffusion model, Large Language Model, Transformer

Scholarship

Shanghai Jiao Tong University B-Level Scholarship **2021 - 2022**

Awarded for academic excellence among peers, representing the top 15% *Shanghai Jiao Tong University*

The Mathematical Contest in Modeling (MCM) Meritorious Winner **2023**

University Honors in Michigan **2024**