

Tianzhe Chu

Web : tianzhechu.com

Email : tianzhechu@gmail.com

Google Scholar: Tianzhe Chu

EDUCATION

- **ShanghaiTech University** Shanghai, China
B.Eng in Computer Science and Technology; GPA:3.75/4.0 Sep 2020 - Jun 2024
Selected Courses: Introduction to Machine Learning, Probability and Statistics, Computer Architecture I, Data Structure and Algorithms, Discrete Mathematics, Signals and Systems, Mathematical Analysis.
- **University of California, Berkeley** Berkeley, CA, US
Visiting undergraduate in EECS; GPA: 3.87/4.0 Aug 2022-May 2023
Graduate Level Courses: Deep Learning, Deep Reinforcement Learning, Foundation of Graphics, Applications of Parallel Computing, Computer Vision, Optimization Model in Engineering

RESEARCH INTEREST

- I'm interested in unsupervised/self-supervised representation learning and interpretable deep learning architectures. My goal is to develop principled learning techniques that model the structures of real-world information at scale, with applications on visual recognition, 3D generation, multimodality, etc.

PUBLICATIONS

(* means equal contribution)

- Yaodong Yu*, **Tianzhe Chu***, Shengbang Tong, Ziyang Wu, Druv Pai, Sam Buchanan, Yi Ma, *Emergence of Segmentation with Minimalistic White-Box Transformers*, **CPAL 2024(Oral)**, **NIPS 2023 XAI Workshop**, <https://arxiv.org/abs/2308.16271>.
- **Tianzhe Chu***, Shengbang Tong*, Tianjiao Ding*, Xili Dai, Benjamin D. Haeffele, René Vidal, Yi Ma, *Image Clustering via the Principle of Rate Reduction in the Age of Pretrained Models*, Under Review(ICLR 2024), <https://arxiv.org/abs/2306.05272>.
- Yaodong Yu, Sam Buchanan, Druv Pai, **Tianzhe Chu**, Ziyang Wu, Shengbang Tong, Benjamin D. Haeffele, Yi Ma, *White-Box Transformers via Sparse Rate Reduction*, **NIPS 2023**, <https://arxiv.org/abs/2306.01129>.
- Druv Pai, Ziyang Wu, Sam Buchanan, **Tianzhe Chu**, Yaodong Yu, Yi Ma, *Masked Completion via Structured Diffusion with White-Box Transformers*, Under Review(ICLR 2024), **CPAL 2024 Recent Spotlight Track**

RESEARCH EXPERIENCE

- **Berkeley Artificial Intelligence Research (BAIR) in UC Berkeley** Berkeley, CA, US
Undergraduate research assistant advised by Prof. Yi Ma Nov 2022-Now
 - In general, seeking low-dimensional structures of high-dimensional natural signals, i.e. images and languages
 - Empirically investigating the properties of white-box transformers
 - Exploring mathematically interpretable deep learning architectures driven by optimizing sparse rate reduction
 - Pushing the limits of image clustering in the age of pre-trained models
- **Shanghaitech Vision and Intelligent Perception (SVIP) Lab** Shanghai, China
Undergraduate research assistant advised by Prof. Shenghua Gao Sep 2023-Now
 - Exploring principled learning frameworks for 3D generation
 - Extending interpretable deep learning architectures into fine-grained vision tasks

SKILLS

- **Languages:** Python, C/C++, Matlab, RISC-V, Mandarin(native), Cantonese, English(fluent, TOEFL: 103)
- **Tools:** PyTorch, Jax, Markdown, git, LaTeX, Blender,

INVITED TALKS

- Presented on White-Box Transformers @ SVIP Lab, Sep 25th, 2023

RESEARCH PROJECT HIGHLIGHTS

- **Emergence Properties in White-box Transformers** Berkeley, CA, US
Summer 2023
Mentor: Prof. Yi Ma
 - We discover that white-box transformer leads to the emergence of segmentation properties in the network's self-attention maps, solely through a minimalistic supervised training recipe.
 - Qualitatively, supervised white-box transformer(named CRATE) learns (i) explicit attention maps with semantic meanings; (ii) structured patch-wise representations with less spurious correlations.
 - Quantitatively, supervised CRATE, though not trained for segmentation, achieves a much higher segmentation score than supervised ViT.
- **Clustering via Principle of rate reduction and Pretrained model** Berkeley, CA, US
Mar 2023 - May 2023
Mentor: Prof. Yi Ma and Dr. Benjamin David Haeffele
 - We propose a novel image clustering pipeline (named CPP) that integrates pre-trained models and rate reduction, enhancing clustering accuracy and introducing an effective self-labeling algorithm for unlabeled datasets at scale.
 - Our pipeline learns a highly clusterable image representation that can be extended to CIFAR-100/ImageNet-1k/LAION-Aesthetic/WikiArt, where few previous methods succeeded in achieving a decent performance.
 - Our pipeline goes beyond deep clustering via proposing solutions for (i) measuring optimal number of clusters; (ii) better image-to-image search; (iii) labeling clusters with semantic meanings.
- **White-box Transformers** Berkeley, CA, US
Feb 2023 - May 2023
Mentor: Prof. Yi Ma
 - We develop white-box transformer-like deep network architectures that are mathematically interpretable and achieve performance very close to ViT.
 - The white-box transformer(named CRATE) is designed as an unrolled optimization of the sparse rate reduction objective over layers. Layers and operators are designed with clear objectives, i.e. modified attention block designed for compression and ISTA block designed for sparsification.
 - I constructed the code base for the architecture, and implemented a layer-wise visualization pipeline to validate the role of each operator.
- **Closed-loop Transcription via Manifold Linearizing and Clustering** Berkeley, CA, US
Nov 2022 - Mar 2023
Mentor: Prof. Yi Ma
 - We explore an unsupervised learning diagram that aims at learning a representation for (i) clustering, and (2) diverse generation.
 - We implement a max-min optimization framework over the unsupervised rate reduction objective, with a proposed distance term measuring the distributional difference between the original data and the generated one.
 - Empirically, the framework works on synthetic manifolds and real world data CIFAR-10.

ACTIVITIES AND AWARDS

- **Outstanding Individual Award as Leader of Social Practice Group** Enshi, Hubei, China
July 2021
Affiliation: ShanghaiTech University
- **Outstanding Individual Award as Member of Industrial Practice Group** Shanghai, China
July 2022
Affiliation: ShanghaiTech University
- **Provincial First Prize for 35th National Physics Olympics Competition** Nanjing, Jiangsu, China
Sep 2018
Affiliation: Suzhou High School of Jiangsu Province