Yu Duan

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Education

Sep 2019 – Jun 2023 | **Institute for Interdisciplinary Information Sciences, Tsinghua University**

- B.S. in Computer Science and Technology (Artificial Intelligence track)
- GPA 3.87/4.0, Junior year GPA 4.0/4.0

Research Experiences

Feb 2022 – Ongoing | **Human-like Capacity Limitation in Multi-system Models of Working Memory**

- Advised by Prof. Robert Yang at the MIT Department of Brain and Cognitive Sciences (BCS) (Lab website link)
- We built an engineering framework to study the neural mechanism of models in many visual working memory tasks; we modeled the visual + cognitive system as CNN + RNN
- We used models to gain novel insights into the long-unsolved problem of WM capacity limitation; we found that human-like capacity limit can only be observed when CNN is pretrained on natural stimuli
- Poster presented at NAIsys2022 and CCN2022, abstract in submission to Cosyne2023

Jun 2022 – Sep 2022 | **Hebbian and Gradient-based Plasticity Enables Robust Memory and Rapid Learning in RNNs**

- Advised by Prof. Kaisheng Ma at Institute for Interdisciplinary Information Sciences (IIIS), Tsinghua University (Lab website link)
- Co-advised by Prof. Yi Zhong at IDG/McGovern Institute, Tsinghua University
- Inspired by the roles of synaptic plasticity in animals, we investigated the benefits of plasticity in RNNs on memory and few-shot learning tasks
- We found that the local Hebbian plasticity is well-suited for memory and associative learning tasks; however, it is outperformed by the non-local gradient-based plasticity on few-shot regression tasks
- Results submitted to ICLR2023

Mar 2021 – Jan 2022 | **Modeling the Fly Olfactory System with Plastic and Compartmentalized RNNs**

- Advised by Prof. Kaisheng Ma and Prof. Yi Zhong
- We aimed to mimic the structure and learning mechanisms of the fly olfactory circuit in RNNs
- We investigated how network performance depends on biological features

Aug 2021 – Jan 2022 | **Atrial Fibrillation Prediction and Biometric Identification with External ECG**

- Advised by Yi Wu at IIIS, Tsinghua University
- In collaboration with cardiologists in hospitals
- We applied transformers to predict Atrial Fibrillation risk and recognize patients' identity from external electrocardiograms

Publication

2022 **Human-like Capacity Limitation in Multi-system Models of Working Memory**
- Yudi Xie*, **Yu Duan***, Aohua Cheng, Pengcen Jiang, Christopher Cueva, Guangyu Robert Yang (*equal contribution)
- Conference on Cognitive Computational Neuroscience (CCN 2022)
- DOI: 10.32470/CCN.2022.1251-0

Papers in Submission

2022 **Hebbian and Gradient-based Plasticity Enables Robust Memory and Rapid Learning in RNNs**
- **Yu Duan**, Zhongfan Jia, Qian Li, Yi Zhong, Kaisheng Ma
- Under review as a conference paper in the Eleventh International Conference on Learning Representations (ICLR 2023)

2022 **Human-like Capacity Limits in Working Memory Models Result from Naturalistic Sensory Constraints**
- Yudi Xie*, **Yu Duan***, Aohua Cheng, Pengcen Jiang, Christopher Cueva, Guangyu Robert Yang (*equal contribution)
- In submission to Computational and Systems Neuroscience (COSYNE 2023)

Honors

2022 **Scholarship for Scientific Innovation, Tsinghua University**

2021 **Scholarship for Academic Excellence, Tsinghua University**

2019 **Freshman Scholarship, Tsinghua University**

2017 **Gold Medal, National Olympiad in Informatics, China**

Selected Coursework

- **AI and AI Applications:** Machine learning, Deep Learning, Natural Language Processing, Computer Vision, Introduction to Robotics, Advanced Computer Graphics
- **Mathematics:** Calculus(1)(2), Linear Algebra, Abstract Algebra, Mathematics for Artificial Intelligence, Probability and Statistics, Introduction of Mathematical Modelling
- **Physics:** General Physics(1)(2), The Physics of Information
- **Theoretical Computer Science:** Algorithm Design, Theory of Computation
- **Cognitive Science:** Cognitive Psychology (2022 Fall)

Selected Course Projects

Fall 2021 | **Solving Vision-Language Tasks with Image Prompts on Frozen Language Models**
- NLP Course project
- We used image embeddings as soft prompts on all transformer layers

Spring 2021 | **Alleviate Mode Collapse in GANs by Utilizing Segmentation Statistics**
- Deep Learning Course project
- We added "segmentation loss" to encourage the model to generate diverse objects

Spring 2021 | **Sketch-to-Image Translation on Noisy Multi-class Datasets**
- Computer Vision Course project
- Application of pix2pix on the sketch-to-image task

Fall 2020 | **Visual Representation Learning via Multiple Self-supervised Tasks**
- AI Course project
- We found that using multiple self-supervised tasks in pre-training yields better visual representations

Skills

- Modeling and Data Processing: Python (especially Pytorch), C++
- Web Engineering: HTML, PHP