

# HAOYUE DAI

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## AREAS OF INTERESTS

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AI Interpretability, Causality, Robust Machine Learning, Language & Vision

## EDUCATION

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**School of Electrical Information and Electrical Engineering, Shanghai Jiao Tong University** 09/2017 - Present

- B.E. (Honored) in Computer Science and Engineering
- Major GPA: **3.88/4.3**, 2020 Year GPA: **4.10/4.3**, Rank: **4/108** in IEEE Honor Class

**Zhiyuan College, Shanghai Jiao Tong University** 03/2018 - Present

- Zhiyuan Honor Program of Engineering (Elite Program for Top 5% of Students at SJTU)

**Department of Electrical & Computer Engineering, University of Washington** 07/2018 - 08/2018

- Courses Completed: C Programming, Embedded Systems Design, Circuit Theory

## RESEARCH EXPERIENCE

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**Seeing Causality Through Latent Ambience** | Microsoft Research Asia (MSRA)

**Advisor:** Justin Ding (Senior Researcher in Data, Knowledge, Intelligence (DKI) Group, MSRA) 07/2020 - Present

- Proposed feature engineering method with consistence and learnability proof on structural causal model, which makes it possible to fully leverage ambient variables in data sample distribution for cause-effect orientation
- Integrated a constraint-based approach with machine learning to boost performance without sacrificing interpretability
- Optimized approximation in conditional independence test and trigger conditions strategy based on all-round empirical studies
- Considered anytime/local/global scenarios and reliability driven by our state-of-the-art skeleton learning algorithm

**What do CNN Neurons Learn: Visualization & Clustering** | Shanghai Jiao Tong University

**Advisor:** John Hopcroft (A.M. Turing Award, Professor of Cornell University) 11/2019 - 02/2020

- Focused on interpreting CNN from aspects of adversarial samples visualization and attention path clustering
- Created an effective method to figure out what neurons learn in CNN by visualizing the input image's focus and reception regions, as well as its feature map spanning vectors in affine subspaces for category prediction
- Designed an unsupervised clustering algorithm to distribute image categories into lower dimension with a defined hierarchy
- Extended the clustering algorithm to construct a filter-wise prediction tree, explicitly indicating which neurons were highly activated in a concrete prediction, and ulteriorly generating the corresponding semantic path

**Interpretation of Speech Recognition Algorithms** | Shanghai Jiao Tong University

**Advisor:** Quanshi Zhang (Associate Professor of John Hopcroft Center for Computer Science) 03/2019 - 11/2019

- Aimed to propose a method to quantitatively characterize a voice sample's significance on different speech recognition models
- Constructed a novel method of interpretation analysis: to disperse voice spectrum along frequency domain
- Designed the differentiable version of dispersion method and implemented the accelerated parallel algorithm in ArrayFire
- Reconstructed the letter based gated ConvNets wav2letter frame to validate it in interpretation analysis
- Conducted experiments and developed a series of well-packaged utilities like IFFT speech regeneration, noise coverage, mask separation, intermediate layers parameter visualization, etc.

**Explaining Mid-Layers in Convolutional Neural Networks** | Shanghai Jiao Tong University

**Advisor:** Quanshi Zhang (Associate Professor of John Hopcroft Center for Computer Science) 09/2018 - 03/2019

- Worked to learn end-to-end interpretable models and build measurement for the semantic information of intermediate layers
- Implemented statistical description in evaluation metrics to distinguish different saliency visual patterns (e.g., part, texture), which are memorized/co-activated in the filters at middle layers
- Comprehensively learned the operation of machine learning frameworks like TensorFlow, MatConvNet. Especially skilled in using PyTorch to construct deep neural networks and conduct further interpretation analysis

**Automatic Paper Illustration Figures Generator** | University of California San Diego

**Advisor:** Pengtao Xie (Assistant Professor of Electrical and Computer Engineering Department) 03/2020 - 06/2020

- Investigated the feasibility of automatically/semi-automatically generating paper figures from the view of contrastive learning
- Designed diagrams dataset and the corresponding algorithms to analyze graph vectors at a semantic level
- Studied models on text2image synthesis, improving their adaptation in various domains using neural architecture search

## SELECTED COURSE PROJECTS

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### Multi-category Classification: Basic Methods & Implementation from Scratch 03/2020 - 06/2020

Course Project for *Machine Learning* (Offered by Quanshi Zhang)

- Implemented and optimized four different techniques (logistic regression, support vector machine, linear discriminant analysis and neural networks) from scratch, with effectiveness nearly matching mainstream machine learning packages
- Collected observations based on numerous trials on MNIST handwritten digits dataset to test algorithm principles
- Compared the performances between different models, scaled datasets, and optimizer schemes with analysis on feature maps by using PCA, visualization methods, and grad-CAM, etc.

### dHealth: A Decentralized Health Code Application 03/2020 - 06/2020

Course Project for *Computer Networks* (Offered by Na Ruan)

- Background: Under the COVID-19 pandemic, health code systems were carried out. Despite the urgency of containing public contagion risk, the systems' transparency, confidentiality, and privacy abuse for digital surveillance issues were questioned
- Developed a decentralized health code system, enabling assessments of public areas without a centralized management
- Designed a smart contract and easy-to-plug API, increasing transparency of the score evaluation process
- Deployed blockchain protocol, distributedly storing users' data with extreme fault tolerance

### Poem Inspire: An Image-Poem Coupled Search & Generation Engine 09/2018 - 12/2018

Course Project for *Introduction to Electrical Engineering C* (Offered by Ya Zhang and Dazhi He)

- Provided lexical semantic prediction & expansion model to give synonym clustering between classical and modern Chinese
- Conducted a Recurrent Neural Network model independently, which generated classical Chinese quatrain from images with widely expanded options from ancient keywords to phonologic features
- Fine-tuned a deep coupled visual-poetic embedding model by multi-adversarial training, which could generate modern Chinese poems from an image. A pipeline from image feature to poetic clues was built from two discriminative networks

### Flappy Bird on Arduino 07/2018 - 08/2018

Course Project for *C Programming & Embedded Systems Design* (Offered by James Peckol)

- Independently transplanted the mobile game to LED display driven by single chip micro-processor
- Applied stochastic oscillator to promote the game's playability

### Acemap-Lite: A Powerful Academic Search Engine 03/2018 - 07/2018

Course Project for *Introduction to Electrical Engineering B* (Offered by Xinbing Wang)

- Implemented a clustered academic database using web crawler and data-mining techniques
- Determined semantic analysis methods to build academic portrait for scholars and predict the possible relationships between scholars, applying Naive Bayesian Classifiers
- Developed a recommendation system based on Neural Collaborative Filtering

## HONORS & AWARDS

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**Chenhao Alumni Scholarship** (5 among 800) 2019

**Arawana Scholarship** (1 among 110) 2018

**Zhiyuan College Honor Scholarship** (Top 5%) 2018 - 2020

**SJTU Academic Excellence Scholarship** (Top 10%) 2018 - 2020

## SKILLS

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**50k+ LoC:** Python (PyTorch, TensorFlow, Numpy)

**10k+ LoC:** C#, C, C++ (Flashlight, ArrayFire)

**1k+ LoC:** Coq, Matlab (MatConvNet), Java, PHP, Verilog HDL, Web Development (HTML, CSS, JavaScript), LaTeX

## ENGLISH PROFICIENCY

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**TOEFL:** 110 (Reading 29, Listening 28, Speaking 25, Writing 28)

**GRE:** Verbal - 155 Quantitative - 170 Analytical Writing - 3.5

**College English Test 4:** 621      **College English Test 6:** 636