Deqing Fu

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Education

2022–2027 **Ph.D in Computer Science**, *University of Southern California*

Honors and Awards: Provost Fellowship

2020–2022 **M.S. in Statistics**, *University of Chicago*

Advisors: Bradley J. Nelson, Lek-Heng Lim
Thesis: Topological Regularization in Deep Learning
Honors and Awards: Susanne H. Rudolph Scholarship

2016–2020 **B.S. in Mathematics & Computer Science**, *University of Chicago*

Honors and Awards: Dean's List (2016-2020)
Liew Family College Research Fellows Fund
Jeff Metcalf Internship Award

Research Interests

- Theories of Machine Learning and Deep Learning
- Computer Vision; Self-Supervised Learning and Representation Learning
- Deep Generative Model and its Artistic Applications
- Topological Data Analysis and its connection with Deep Learning

Publications

[1] **Deqing Fu** and B. J. Nelson, "Topological regularization for dense prediction," *ArXiv*, vol. abs/2111.10984, 2021.

[2] C. Nederhood, N. I. Kolkin, **Deqing Fu**, and J. Salavon, "Harnessing the conditioning sensorium for improved image translation," *2021 IEEE/CVF International Conference on Computer Vision (ICCV)*, pp. 6732–6741, 2021.

[3] S. H. K. Narayanan, P. D. Hovland, K. Kulshreshtha, D. Nagarkar, K. Macintyre, R. Wagner, and **Deqing Fu**, "Comparison of two gradient computation methods in python," *2017 NeurIPS Workshop on Automatic Differentiation*, 2017.

Research Experience

2020-2022 **Research Assistant**, *Department of Statistics, University of Chicago*
Supervisors: Prof. Lek-Heng Lim and Dr. Bradley Nelson

- Initiated the idea of using **Topological Regularization**, based on **Persistent Homology**, to improve the training process by controlling the topology of intermediate activations in Convolutional Neural Networks. Experimented with this idea on solving Depth Estimation and Semantic Segmentation problems. Conducted experiments on both U-Net and state-of-the-art DenseDepth models with different levels of topological control
- Extended the idea of Topological Regularization to time-dependent tasks. Experimented with the idea of solving **Next-Frame Prediction problems**. Working on real-life data as such Beijing Taxi Dataset
- Extending mathematical intuitions on deep learning to a larger project of **Time-Aware Machine Intelligence**

2020-2021 **Machine Learning Research Assistant**, *Jason Salavon Studio & University of Chicago*
Supervisor: Prof. Jason Salavon
- Collected and pre-processed two new datasets, a modified in-the-wild dataset (FFHQ-Wild) of 70,000 images, and a proprietary television series dataset (ClassicTV) of 40,000 images
- Initiated the idea of using multiple conditionings, including segmentations, face landmarks, and depths, etc., for our Generative Adversarial Network-based **Image Style Translation** framework. Trained the new framework on CelebA-HQ and the new datasets, FFHQ-Wild and ClassicTV
- Benchmarked our model against other state-of-the-art methods. The new method achieved significant better Fréchet Inception Distance (FID) scores with an average improvement of 39.3%

2019-2021 **Research Assistant**, *Department of Computer Science, University of Chicago*
Supervisor: Prof. Michael Maire
- Researching on **Amodal Image Segmentation** to infer segmentations of visible and occluded parts of objects
- Proposed and experimented with a multi-level sheet model as an approach to make object connectivity and occlusion relationships explicit
- Extended the **Spectral Clustering** method and applied it as a post-processing technique to a learned multi-level affinity matrix. Trained multiple baseline models on the COCO-Amodal Dataset
- Experimented with a novel **Self-supervised Learning** framework that uses generative adversarial networks (GANs) as inpainters to improve the performance of Contrastive Learning models on segmentation tasks

2017 **Summer Student Research Assistant**, *MCS Division, Argonne National Laboratory*
Supervisors: Dr. Paul Hovland & Dr. Sri Hari Krishna Narayanan
- Benchmarked the efficiency of ADOL-C, an **Automatic Differentiation** algorithm, and implemented a toy LSTM model with ADOL-C in Python

Professional Experience

2022 **Software Engineer Intern**, *Google*, Mountain View, CA

2021 **Software Engineer Intern**, *Google*, Mountain View, CA
- Developed a semantically-aware machine learning algorithm to analyze similar images. Evaluated the performance of different clustering methods, including K-Means, Mean Shift, and Affinity Clustering, on Google Lens datasets.
- Proposed and implemented a multi-stage clustering-and-deduping algorithm to group similar images together. The algorithm combines an offline **Affinity Clustering**-based clustering algorithm and an online merging algorithm to achieve the better quality and latency. This new machine-learning-based algorithm improved user satisfaction rate by 1.02%, compared to the existing wavelet-based algorithm.
- Initiated the idea of using models for recommendation systems, such as the **Deep and Wide** model, to optimize users' click-through-rate on Lens' image search results.

2018 **Software Engineer Intern**, *Industrial Toys, Electronic Arts*, Pasadena, CA
- Implemented game logic for the prototype of a new mobile title for the well-known *Battlefield* game series using the Unreal Engine 4. Developed tools for engineering and art teams, debugged, and optimized existing functionalities of the game prototype.

Teaching Experience

Teaching Assistant

Fall 2021 **BUSN 41301**, *Statistical Insight into Marketing, Consulting, and Entrepreneurship*

Winter 2018 **MATH 15300**, *Calculus - III*

Fall 2017 **MATH 15200**, *Calculus - II*

Grader

Fall 2021 **CMSC 31230**, *Fundamentals of Deep Learning*

Spring 2020 **STAT 24620**, *Multivariate Statistics and Data Analysis*

Winter 2019 **MATH 20100**, *Mathematical Methods for Physical Science*

Fall 2018 **MATH 19520**, *Mathematical Methods for Social Science*

Spring 2018 **MATH 20300**, *Analysis in Rn - I*