Yo Joong "YJ" Choe

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RESEARCH INTERESTS

Statistical Machine Learning
Nonparametric and High-Dimensional Statistics
Generative Latent Variable Models

EDUCATION

Carnegie Mellon University, Pittsburgh, PA, Aug 2015 - May 2020

Ph.D. Student in Machine Learning and Statistics
Advisor: Undecided

University of Chicago, Chicago, IL, Sep 2011 - Jun 2015

B.S. with Honors in Mathematics and Computer Science

HONORS & AWARDS

Phi Beta Kappa (Top 5% of Class), University of Chicago, 2014
Dean's Fund for Student Life, University of Chicago, 2014
Dean's List, University of Chicago, 2011-2015

RESEARCH PROJECTS

Understanding the Structure-Function Relationship in Brain Networks Current
Advised by Prof. Aarti Singh and Prof. Tim Verstynen

The brain architecture is captured by structural neuroimaging techniques such as diffusion spectrum imaging (DSI), which measures the diffusion of water in brain tissue, while neural activities are captured by functional neuroimaging techniques such as functional magnetic resonance imaging (fMRI), which measures changes in blood flow within the brain.

Based on recent developments in local connectome fingerprinting (LCF), which provides a high-dimensional quantitative measure of local connectivity from brain images, we are building a statistical model that relates the two different kinds of connectivity measurements, and we hope this model to give an insight into the role of structure-function relationship in human cognition and action.

Sparse Additive Models with Shape Constraints [REU Paper] [Slides] [Code]
Advised by Prof. John Lafferty
Joint work with Sabyasachi Chatterjee and Min Xu
As part of Chicago Theory Center CS REU Summer 2014

I was part of a team that is studying a new type of high-dimensional regression model that fits an additive model where each component is either convex, concave, or identically zero. This led to a challenging and fascinating problem we call "convexity pattern selection," which is to infer the correct sparsity *and* convexity pattern of p variables, among the 3^p possible patterns. Other shape constraints such as monotonicity can be used. These models extend the idea of sparse additive models (Ravikumar et al. 2009).

I have contributed to the problem formulation and development of these ideas, and wrote a set of R codes to explore approaches based on convex and non-convex optimization. We are currently working to give a rigorous proof of consistency for one such algorithm.

Log-SOS-Concave Density Estimation [REU Paper by Cytrynbaum and Hu]
Advised by Prof. John Lafferty
Joint work with Max Cytrynbaum and Wei Hu
As part of Chicago Theory Center CS REU Summer 2014

Combining the ideas of log-concave density estimation (Cule and Samworth 2009) and sum-of-squares (SOS) convexity (Ahmadi 2010, Lasserre 2009), we developed density estimation and graphical modeling methods using log-SOS-concave functions. We studied a projected gradient descent approach using semidefinite programming (SDP) and time-varying sampling techniques (Narayanan and Rakhlin 2013).

Cytrynbaum and I studied SOS-convexity and semidefinite programming techniques to come up with a primitive formulation of SOS-convex regression, which was used to formulate the projection problem for density estimation as a semidefinite program.

Deep Learning and Socioeconomic Inference [Blog Post]
Advised by Prof. James Evans
Joint work with Nathaniel Sauder, Zhongtian Dai, Rafael Turner, and Vrushank Vora
Knowledge Lab, Computation Institute, University of Chicago

Sociologists design and conduct extensive surveys to study factors behind high crime rates or low income levels in certain neighborhoods. Aiming to build an effective alternative to these costly and time-consuming methods, we studied data-driven methods that model the latent factors using neighborhood-level image data from Google Street View.

We implemented a prediction model using the ImageNet-pretrained features of Caffe, an efficient convolutional neural network (ConvNet) implementation for image classification (Jia et al. 2014). Tested for a binary classification task on neighborhood-level income data, this model led to a 97% area-under-curve (AUC) score. We also collected survey data using the Amazon Mechanical Turk (MTurk) service where we asked people to compare the perceived safety and affluence given two images. I built the MTurk web app and maintained a survey page built on Python Django and MongoDB.

The Bhattacharyya Kernel Between Sets of Vectors [REU Paper]
Mentored by Angela Wu and Prof. Risi Kondor
As part of University of Chicago Mathematics REU Summer 2013

As a full participant in the Mathematics REU program, I studied a kernel defined on bags of vectors using the Bhattacharyya distance, as proposed by Jebara and Kondor in 2003. I studied kernel methods such as kernel principal component analysis, the theory of reproducing kernel Hilbert spaces (RKHS), and regularized covariance estimation in an RKHS.

Increasing Chromatic Number and Girth [REU Paper]
Mentored by Vaidahee Thatte and Prof. László Babai
As part of University of Chicago Mathematics REU Summer 2012

As a first-year participant in the Mathematics REU program, I studied one of Erdös' theorems that there exists a graph with arbitrarily large chromatic number and girth. In particular, I studied the proof of Kneser's conjecture, moment curves, Gale's theorem on the distribution of points on the sphere, Borsuk graphs, and Kneser graphs.

SELECTED COURSEWORK

Carnegie Mellon University

- *Machine Learning:* Statistical Machine Learning, Advanced Intro to Machine Learning
- *Statistics:* Intermediate Statistics, Regression Analysis, Advanced Probability Overview

University of Chicago

- *Machine Learning & Statistics:* Machine Learning & Large-Scale Data Analysis, Nonparametric Inference, High-Dimensional Statistics I, Computational Linguistics, Intro to Artificial Intelligence, Topics in Graphical Models (audit)
- *Computer Science:* Databases, Functional Programming, Theory of Algorithms, Mathematical Toolkit, Complexity Theory
- *Mathematics:* Matrix Computation I-II, Modern Approximation Theory, Honors Real Analysis I-II-III, Honors Abstract Algebra I-II-III, Point-Set Topology

TEACHING EXPERIENCES

As a Teaching Assistant

Intro to Probability Modeling (Balakrishnan, CMU), Statistical Computing (Tibshirani, CMU), Machine Learning and Large-Scale Data Analysis (Lafferty, UChicago)

As a Grader

Foundations of Computational Data Analysis (Chaudhary, UChicago), Nonparametric Inference (Lafferty, UChicago), Computer Science with Applications I (Rogers, UChicago), Calculus I-II-III (Bapat, UChicago)

TECHNICAL SKILLS

Data Science R, Matlab, Apache Spark, SQL
Programming Python, C, Java, Elm, JavaScript, Racket
Environments Amazon Web Services (EC2), Linux/Unix Shells, Git

LANGUAGES English, Korean