Harshvardhan

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Interests : Machine Learning, Optimization, Learning Theory

EDUCATION

SWISS FEDERAL INSTITUTE OF TECHNOLOGY, LAUSANNE (EPFL)

MS in Data Science
Expected Aug 2021
Grade : 5.5 /6

INDIAN INSTITUTE OF TECHNOLOGY, KANPUR

BTech in Electrical Engineering,Minor in Artificial Intelligence
Jun 2019, CPI : 9.5/10.0

PUBLICATIONS

- V. Singh, H. Vardhan, N. K. Verma and Y. Cui, "Optimal Feature Selection using Fuzzy Combination of Feature Subset for Transcriptome Data," 2018 IEEE International Conference on Fuzzy Systems (FUZZ-IEEE), Rio de Janeiro, 2018, pp. 1-8.

ACHIEVEMENTS

- Received IIT Kanpur Academic Excellence Award for 2015-16 and 2016-17, awarded to top 10% students in a batch.
- Among top 1% in the National Standard Examination in Chemistry.
- All India Rank 263 in JEE Advanced 2015 and All India Rank 1324 in JEE Mains 2015 among 1.5 M students.
- Qualified for Indian National Mathematics Olympiad(INMO) twice(2013,2014)

SELECTED PROJECTS

OPTIMAL BATCH SIZE PER ITERATION

Supervisors : Martin Jaggi,Sebastian Stich | Sep 2019 - June 2020 | Semester Project

- Obtained a theoretically-optimal batch size per iteration for finite-sum mini-batch SGD for convex objectives.
- Analysed optimal per iteration v/s same optimal batch size for all iterations, establishing a theoretically optimal batch size framework for SGD with batch size increasing with error.
- Established batch size and step size equivalence for convergence-diagnostic based adaptive step size and batch size control algorithms for SGD.
- Designed a new gradient norm based test for detecting SGD convergence. Tested batch size control and GradNorm test to obtain comparable performances.

CONSTRAINED STOCHASTIC COMPOSITIONAL DESCENT

Supervisor : Ketan Rajawat|August 2018 - Sep 2019 | Undergraduate Project - II ,III

- Proposed a novel algorithm , inspired from SCGD,for minimizing objective functions of the form $\mathrm{E}[f(\mathrm{E}[g(x)]]$ with constraints as $\mathrm{E}[h(x)] \leq \gamma$.
- Established bounds on the convergence rates as well as time-averaged constraint violation for the algorithm for constant and variable step sizes for convex objectives along with a special case of zero constraint violation under mild assumptions.
- Evaluated the algorithm's performance on synthetic and Adult datasets to solve fair classification problem using Risk Difference fairness constraint and a novel fair formulation of the SpAM problem. A draft of this work has been submitted to Mathematical Programming.

STOCHASTIC HAMILTONIAN DESCENT

Supervisor : Ketan Rajawat|Jan 2019 - April 2019 | Convex Optimization Course Project

- Proved convergence of a stochastic variant of the First Explicit Method of Discretization of Hamiltonian Descent Methods with same bounds as the deterministic version under certain strict stochastic assumptions.
- Formulated a toy implementation of the stochastic variant by explicitly adding noise to the actual gradient.

ROBUST TRAINING FOR NEURAL NETWORKS

Supervisor: Purushottam Kar| January 2018 - April 2018 | Learning Theory Course project

- Designed a novel alternating-optimization based training algorithm for a single hidden layer NN with ReLU activation.
- Divided training procedure into 3 stages -sparse recovery for choosing the sign of weights and separate regression procedures for the positive and negative weights.
- Proved the rates of convergence for this algorithm under mild assumptions on the weights and input.

ADVERSARIAL ATTACKS ON QSGD AND EF-SIGNSGD WITH GOSSIP COMMUNICATION

Martin Jaggi| April 2020 - June 2020|Optimization in ML course project

- Implemented qSGD and EF-signSGD on MNIST for distributed gossip based optimization with byzantine nodes which send reversed gradients, and median-based and fractional mean based protection schemes for ring and torus.
- Empirical Convergence for 44% corruption.

JUNIOR MACHINE LEARNING ENGINEER

Employer : Visium SA|Sep 2020 - Jan 2021 | Master's industrial Internship

- Extended dockerized training, evaluation and inference pipelines for BERTQA models to extract information from contracts.
- Implemented outlier detection, generalization to other inputs, and item specific scaling in CNN based forecasting pipeline.

MYFOODREPO

Supervisor: Marcel Salathe,Martin Jaggi| May 2018 - July 2018|Summer@EPFL 2018 Research Intern

- The MyFoodRepo project aims to produce accurate nutritional value estimates from images of food items.
- My work involved training the baseline Tortilla image classifier on a private dataset of food images, handling class imbalance.
- Set up a coco-ui like segmentation interface on MTurk, and a webcrawler for obtaining further training data.
- Proposed methods to handle hierarchical classification performance.

FEATURE SELECTION USING FUZZY SETS

Supervisor: Dr Nishchal K. Verma | May 2017 – January 2018| Undergraduate Project - I

- Designed a novel algorithm for cluster-sensitive feature selection which assigns fuzzy memberships to feature subsets selected by filter methods.
- Implemented the approach using mRMR filters and got improved cross-validation accuracy than mRMR on standard biological datasets like arcene, Prostate-GE and colon.

COURSEWORK

Introduction to Machine Learning	Learning Theory	Natural Language Processing
Probabilistic Modeling and Inference	Random Networks	Optimization in ML
Statistical Signal Processing	Information Theory	Time Series Analysis
Game Theory and Mechanism Design	Wavelet Transforms for Image Processing	Randomized Algorithms
Visual Recognition	Stats for Data Science	Computational Cognitive Sciences
Detection and Estimation Theory	Algorithmic Information Theory	Convex Optimization
Applied Data Analysis	Risk,rare events and extremes	Stochastic Calculus
Deep Learning	Adv Algorithms	Adv Probability

SKILLS

Programming
Matlab • Python • C++ • Bash
Javascript •C

Simulators
Gazebo • Micro-Cap • Altium
Solidworks • LTLMoP

Frameworks
ROS •OpenCV • Arduino
Scikit•PyTorch •Git
Flask •Plotly •Docker

More details about projects on webpage