Zhenyang Zhang

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Research Interests

Optimization, data-driven algorithm design, modeling and applied geometry.

Technical Skills

Proficient in Data Analytics, Optimization Algorithms and Statistical Modeling (Linear Regression, Time Series, Stochastic Process and Neural Networks).

Programming Languages

Python
R
Java
SQL
Matlab
C

Python Libraries

Numpy
Tensorflow
Pandas
PySQL
Cplex
Gurobipy
SCIP/PySCIPOpt
Qiskit

Education

2017 – PhD expected: 2022 — **Graduate Program in Math** — University of California, Davis
Advisor: Jesús De Loera. GPA: 3.620.

2013 – 2017 — **B.A. in Applied Math and B.A. in Statistics** — University of California, Berkeley
Dean's Honor List in Fa13, Sp14, Fa14, Sp15, Fa15 and Sp16.
Research Advisors: David Aldous (Statistics), Yan Zhang (Combinatorics). GPA: 3.923.

Working Experience

2021.6 – 2021.9 — **Intern (Research and Development Group)** — Pingcap Inc.
– Built optimization models via SCIP and PySCIPOpt based on machine learning prediction for migrating hot regions.
– Resolved the problem of previous strategy of potentially moving data back and forth by local searching optimization. Make the sharding strategy more robust by avoiding the necessity of human interference.
– Wrote paper draft for dynamic sharding strategies in large-scale distributive database TiDB.

Research Projects

2020-2021 — **Machine learning application on discrete algorithms**

– Applied machine learning techniques to improve the performance of two classical algorithms: simplex method and all-pair shortest paths algorithm.
– Trained and compared deep neural network (via tensorflow), gradient boosted tree classfication and regression models (via xgboost).
– Model for all-pair shortest paths algorithm has prediction accuracy 93.3% with performance only 0.07% slower than the optimal strategy. Model for simplex algorithm outperforms the steepest edge pivot rule and is only 3% slower than the optimal.

2021 — **Study of ideas on the realization of quantum machine learning**

– Investigated Swaptest, the fast computation of inner products and its potential application to quantum support vector machines and quantum k-means clustering.
– Studied attempts on building quantum neural networks (the special cases of Hopfield networks and fuzzy feed-forward NN).

2020 — **Enumerative problems for arborescences and monotone paths on polytopes**

– Studied the theoratical behavior of the simplex method by number of paths, number of arborescences and flip graph.
– Wrote python and matlab code from scratch to generate random polytopes, build flip graph, and compute diameter and other properties of interest.
– Investigated the extremal cases in 3d and 4d polytopes and other well-known polytopes (Archimedean solids and Platonic solids).

2019 — **Oriented matroids and cocircuit graph**

– Built python class for oriented matroids from scratch to compute the properties we are interested in.
– Searched through all small oriented matroid isomorphism classes (about 2 billion) to find interesting examples.
– Investigated and disproved some classic conjectures on oriented matroids, cocircuit graph and Hirsch related conjecture based on our computational search.

Research Papers

2021 **(Machine)Learning to Improve the Empirical Performance of Discrete Algorithms**
Collaboration with Imran Adham and Jesús De Loera
Submitted to CPAIOR

2020 **Enumerative problems for arborescences and monotone paths on polytopes**
Collaboration with Christos Athanasiadis and Jesús De Loera
Journal of Graph Theory. https://doi.org/10.1002/jgt.22725

2020 **Diameters of Cocircuit Graphs of Oriented Matroids: an update**
Collaboration with Ilan Adler, Jesús De Loera and Steven Klee
Submitted to the Electronic Journal of Combinatorics

Invited Talks

May 2019 **Poster: "On the Diameter of Oriented Matroid Programs"** Ann Arbor, MI
IPCO 2019 (Integer Programming and Combinatorial Optimization)

Sep 2019 **"On the Diameter of Oriented Matroids"** South Padre Island, TX
Tenth Discrete Geometry and Algebraic Combinatorics Conference

Oct 2019 **"On the Diameter of Oriented Matroids"** Binghamton, NY
American Mathematical Society Fall Eastern Sectional Meeting Special Session: Oriented Matroids and Related Topics

Teaching Experience

2015, 2016 Undergraduate student instructor (TA) for Berkeley Math Department on Math 54 (Linear algebra) and Math 172 (Combinatorics)

2017–Now Teaching Assistant for Davis Math Department on Calculus Series, Math 22A (Linear algebra) and Math 258A (Graduate Discrete Optimization). Average 4.36/5 rating in the recent courses taught.

Summer 2018 Associate Instructor for Math 21D (Multivariate Calculus). Fully in charge of writing syllabus, homeworks, exams and giving lectures.

Relevant Coursework

UC Berkeley	MAT 53 Multivariable Calculus	A+
	MAT 54 Linear Algebra and Differential Equations	A+
	MAT 55 Discrete Math	A+
	MAT 104 Introduction to Analysis	A
	MAT 110 Linear Algebra	A
	MAT 113 Abstract Algebra	A
	MAT 115 Introduction to Number Theory	A
	MAT 116 Cryptography	A+
	MAT 128A Numerical Analysis	A+
	MAT 136 Theory of Incompleteness and Undecidability	A
	MAT 172 Combinatorics	A
	MAT 185 Complex Analysis	A
	MAT 202A Topology and Analysis	A-
	MAT 202B Functional Analysis and Fourier Analysis	A
	MAT 249 Algebraic Combinatorics	A
	MAT 250A Groups Rings Fields	A-
	STAT 133 Computing Data	A
	STAT 134 Probability	A+
	STAT 135 Concepts of Statistics	A
	STAT 150 Stochastics Process	A+
	STAT 151A Linear Modeling	A-
	STAT 155 Game Theory	A+
	STAT 157 Topics in Statistics	A-
	CS 61A Structure and Interpretation of Computer Programs	A+
	CS 61B Data Structures	A
	CS 61C Ideas in Computer Architecture	Audit
	CS 170 Introduction to CS Theory	A
	CS 189 Introduction to Machine Learning	A
	CS 270 Algorithm and Data Structure	A
	CS 276 Cryptography	Audit
UC Daivs	MAT 201A Analysis	A-
	MAT 201B Analysis	A
	MAT 201C Analysis	B
	MAT 205A Complex Analysis	B
	MAT 215A Topology	A-
	MAT 226A Numerical Methods	A
	MAT 235A Probability Theory	A
	MAT 236A Stochastic Dynamics	A
	MAT 245 Enumerative Combinatorics	A
	MAT 246 Algebraic Combinatorics	A
	MAT 250A Algebra	A-
	MAT 250B Algebra	A-
	MAT 250C Algebra	A-
	MAT 258A Numerical Optimization	A
	MAT 258B Discrete Optimization	B+
	ECS 222A Analysis of Algorithm	A-
	STAT 208 Statistical Machine Learning	A
	EEC 289L Quantum Computing	A-