

Anastasios Kyrillidis

CONTACT INFORMATION

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RESEARCH INTERESTS

Optimization for machine learning, convex and non-convex analysis and optimization, structured low dimensional models, large-scale computing, quantum computing.

ACADEMIC APPOINTMENTS

Rice University, Houston, USA

Noah Harding Assistant Professor at Computer Science Dept.

July 2018 - now

University of Texas at Austin, Austin, USA

Simons Foundation Postdoctoral Researcher
Member of WNCG

November 2014 - August 2017

PROFESSIONAL APPOINTMENTS

IBM T.J. Watson Research Center, New York (USA)

Goldstine PostDoctoral Fellow

September 2017 - July 2018

EDUCATION

École Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland

Ph.D., School of Computer and Communication Sciences, September 2010 - October 2014.

TEACHING AND SUPERVISING EXPERIENCE

Instructor

Rice University

- COMP 414/514 — Optimization: Algorithms, complexity & approximations

— Fall '19

- Students enrolled: 30 (28 G/2 UG)
- Class evaluation — Overall quality: 1.54 (Rice mean: 1.76); Organization: 1.57 (Rice mean: 1.75); Challenge: 1.5 (Rice 1.73)
- Instructor evaluation — Effectiveness: 1.43 (Rice mean: 1.67); Presentation: 1.39 (Rice mean: 1.73); Knowledge: 1.29 (Rice mean: 1.56).

— Fall '20

- Students enrolled: 30 (8 G/22 UG)
- Class evaluation — Overall quality: 1.29 (Rice mean: 1.69); Organization: 1.28 (Rice mean: 1.69); Challenge: 1.31 (Rice 1.68)
- Instructor evaluation — Effectiveness: 1.21 (Rice mean: 1.58); Presentation: 1.17 (Rice mean: 1.63); Knowledge: 1.14 (Rice mean: 1.49).

- COMP 545 — Advanced topics in optimization: From simple to complex ML systems

— Spring '19

- Students enrolled: 10
- Class evaluation — Overall quality: 1.31 (Rice mean: 1.78); Organization: 1.23 (Rice mean: 1.79); Challenge: 1.46 (Rice mean: 1.75).
- Instructor evaluation — Effectiveness: 1.23 (Rice mean: 1.68); Presentation: 1.23 (Rice mean: 1.75); Knowledge: 1.23 (Rice mean: 1.57).

— Spring '20

- Students enrolled: 13
- Class evaluation — Overall quality: 1.55 (Rice mean: 1.69); Organization: 1.55 (Rice mean: 1.69); Challenge: 1.55 (Rice mean: 1.69).
- Instructor evaluation — Effectiveness: 1.27 (Rice mean: 1.59); Presentation: 1.36 (Rice mean: 1.67); Knowledge: 1.18 (Rice mean: 1.5).

Student Advising

Rice University

- Chen Dun (PhD student / 2019 -) - Distributed learning of neural networks, active learning, efficient transformers.
- Lyle Kim (PhD student / 2019 -) - Fast inverse algorithms for quantum state tomography, Implicit motions in gradient descent.
- Carlos Quintero (PhD student - co-advised with Lydia Kavraki / 2019 -) - Robustness in robotics.
- Zhiwei Zhang (PhD student - co-advised with Moshe Vardi / 2019 -) - Interplay of discrete and continuous methods for fast SAT solving.
- John Chen (PhD student / 2020 -) - Adaptive hyperparameter techniques for ML, Semi-supervised learning, Overparameterization, Contrastive learning.
- Cameron Wolfe (PhD student / 2020 -) - Distributed learning of neural networks, active learning, efficient transformers
- Jasper Liao (MSc student / 2020 -) - Optimization techniques for inverse problems with deep learning, Intrinsic dimension in neural networks.
- Qihan Wang (UG student) - Efficient distributed techniques for lottery ticket hypothesis in neural networks.

UT Austin

- Vatsal Shah (Ph.D. student at WNCG group) - Stochastic large-scale optimization for machine learning.
- Srinadh Bhojanapalli (Ph.D. student at WNCG group - now at Google) - Non-convex matrix factorization problems.
- Dohyung Park (Ph.D. student at WNCG group - now at Facebook) - Non-convex matrix factorization problems.
- Megasthenis Asteris (Ph.D. student at WNCG - now at Google) - Sparse PCA/CCA algorithms with applications in neuroscience.

FUNDING, AWARDS, DISTINCTIONS & MISC.

Academic year 2018-2019

— Awarded: NSF CCF core program (small), #1907936, \$470K, 2019/10 - 2022/09, “Efficient and robust characterization of quantum systems”.

Academic year 2019-2020

— Awarded: NSF-MLWiNS (Co-PI with Chris Jermaine and Yingyan Lin), #2003137, \$450K, 2020/06 - 2023/05, “Wireless On-the-Edge Training of Deep Networks Using Independent Subnets”.

Academic year 2020-2021

— Awarded: Creative Venture Funds (PI with Leonardo Duenas-Osorio and Kaden Hazard), \$75K, 2020/?? - 2021/??, “Classical Optimization meets Quantum Computation for Practical Quantum Approximation Optimization Algorithms”.

Misc.

Workshop on non-convex methods at ICML 2020: *Beyond first-order methods in ML systems*.

Workshop on non-convex methods at NeurIPS 2019: *Beyond first-order methods in ML*.

Workshop on non-convex methods at ICML 2016: *Advances in non-convex analysis and optimization*.

Awards

Goldstine fellowship at IBM among more than 100 applicants.

Simons Foundation scholarship for PostDoc studies at UT Austin.

AAAI 2014 Travel Student award (\$1000).

Graduate Studies Fellowship Award:

- EPFL Ph.D. fellowship, 2010 (60,000 CHF).
- Alexander S. Onassis Public Benefit Foundation (€ 20,000 between 2008-2010).
- Special Research Fund Account, Technical University of Crete, 2008-2010 (€ 5,000 between 2008-2010).

PUBLICATIONS (REVERSE CHRONOLOGICAL ORDER)

Conference Papers

- Jacky Zhang, Rajiv Khanna, Anastasios Kyrillidis, Sanmi Koyejo, “Bayesian Coresets: Revisiting the Nonconvex Optimization Perspective”, Conference on Artificial Intelligence & Statistics (AISTATS), 2021 (**Oral - 2%**).
- Anastasios Kyrillidis, Moshe Vardi, and Zhiwei Zhang (main contributor), “On Continuous Local BDD-Based Search for Hybrid SAT Solving”, Conference on Artificial Intelligence (AAAI), 2021.

- John Chen, Vatsal Shah and Anastasios Kyrillidis, “Negative sampling in semi-supervised learning”, International Conference on Machine Learning (ICML), 2020.
- Kelly Geyer, Anastasios Kyrillidis, and Amir Kalev, “Low-rank regularization and solution uniqueness in over-parameterized matrix sensing”, Conference on Artificial Intelligence & Statistics (AISTATS), 2020.
- Anastasios Kyrillidis, Anshumali Shrivastava, Moshe Vardi, and Zhiwei Zhang (main contributor), “Fourier-SAT: A Fourier Expansion-Based Algebraic Framework for Solving Hybrid Boolean Constraints”, Conference on Artificial Intelligence (AAAI), 2020.
- Jacky Y. Zhang, Rajiv Khanna, Anastasios Kyrillidis, and Oluwasanmi O. Koyejo, “Learning Sparse Distributions using Iterative Hard Thresholding”, Neural Information Processing Systems (NeurIPS), 2019.
- Ryan Spring, Anastasios Kyrillidis, Vijai Mohan, Anshumali Shrivastava, “Compressing Gradient Optimizers via Count-Sketches”, International Conference on Machine Learning (ICML), 2019.
- Anastasios Kyrillidis, “Simple and practical algorithms for ℓ_p -norm low-rank approximation”, Conference on Uncertainty in Artificial Intelligence (UAI), 2018.
- Rajiv Khanna and Anastasios Kyrillidis, “IHT dies hard: Provable accelerated Iterative Hard Thresholding”, Conference on Artificial Intelligence & Statistics (AISTATS), 2018.
- Tianyang Li, Liu Liu, Anastasios Kyrillidis, and Constantine Caramanis, “Statistical inference using SGD”, Conference on Artificial Intelligence (AAAI), 2018.
- Dohyung Park, Anastasios Kyrillidis, Constantine Caramanis, and Sujay Sanghavi, “Non-square matrix sensing without spurious local minima via the Burer-Monteiro approach”, Conference on AI & Statistics (AISTATS), 2017.
- Dohyung Park, Anastasios Kyrillidis, Constantine Caramanis, and Sujay Sanghavi, “Finding low-rank solutions to matrix problems via the Burer-Monteiro approach, efficiently and provably”, IEEE Allerton Conference, 2016.
- Srinadh Bhojanapalli, Anastasios Kyrillidis, and Sujay Sanghavi, “Dropping convexity for faster semi-definite optimization”, Conference on Learning Theory (COLT), 2016.
- Megasthenis Asteris, Anastasios Kyrillidis, Oluwasanmi Koyejo, and Russell Poldrack, “A simple and provable algorithm for sparse diagonal CCA”, International Conference on Machine Learning (ICML), 2016.
- Anastasios Kyrillidis, Bubacarr Bah, Rouzbeh Seyed Hasheminezhad, Luca Baldassarre, Quoc Tran-Dinh and Volkan Cevher, “Convex block-sparse linear regression with expanders, provably”, Conference on AI & Statistics (AISTATS), 2016.
- Megasthenis Asteris, Anastasios Kyrillidis, Dimitris Papailiopoulos and Alex Dimakis, “Bipartite correlation clustering - Maximizing agreements”, Conference on AI & Statistics (AISTATS), 2016.
- Hemant Tyagi, Anastasios Kyrillidis, Andreas Krause and Bernd Gartner, “Learning sparse additive models with interactions in high dimensions”, Conference on AI & Statistics (AISTATS), 2016.
- Megasthenis Asteris, Dimitris Papailiopoulos, Anastasios Kyrillidis, and Alex Dimakis, “Space PCA via bipartite matchings”, Neural Information Processing Systems (NIPS), 2015.
- Megasthenis Asteris, Anastasios Kyrillidis, Alex Dimakis, Han-Gyol Yi and Bharath Chandrasekaran, “Stay on path: PCA along graph paths”, International Conference on Machine Learning (ICML), 2015.
- Michail Vlachos, Francesco Fusco, Harry Mavroforakis, Anastasios Kyrillidis and Vassilis Vasileiadis, “Scalable and robust co-clustering of large customer-product graphs”, International Conference on Information and Knowledge Management (CIKM), 2014.
- Dimitris Papailiopoulos, Anastasios Kyrillidis and Christos Boutsidis, “Provable deterministic leverage scores sampling”, ACM SIGKDD Conference on Knowledge Discovery and Data Mining (KDD), 2014.
- Anastasios Kyrillidis, Rabeeh Karimi Mahabadi, Quoc Tran-Dinh and Volkan Cevher, “Scalable sparse covariance estimation via self-concordance”, Conference on Artificial Intelligence (AAAI), 2014.
- Anastasios Kyrillidis, Michail Vlachos and Anastasios Zouzias, “Approximate matrix multiplication with application to linear embeddings”, IEEE ISIT Symposium, 2014.
- Anastasios Kyrillidis and Anastasios Zouzias, “Non-uniform feature sampling in decision tree ensembles”, IEEE ICASSP, 2014.
- George Skoumas, Dieter Pfoser and Anastasios Kyrillidis, “On quantifying qualitative geospatial data: A probabilistic approach”, ACM GEOCROWD 2013.

- Stephen Becker, Volkan Cevher and Anastasios Kyrillidis, “Randomized low-memory singular value projection”, 10th International Conference on Sampling Theory and Applications (SampTA), 2013. (Authors listed in alphabetical order.)
- Anastasios Kyrillidis, Stephen Becker, Volkan Cevher and Christoph Koch, “Sparse projections onto the simplex”, International Conference on Machine Learning (ICML), 2013.
- Quoc Tran Dinh, Anastasios Kyrillidis and Volkan Cevher, “A proximal Newton framework for composite minimization: Graph learning without Cholesky decompositions and matrix inversions”, International Conference on Machine Learning (ICML), 2013.
- Anastasios Kyrillidis and Volkan Cevher, “Fast proximal algorithms for self-concordant minimization with application to sparse graph selection”, IEEE ICASSP, 2013.
- Anastasios Kyrillidis and Volkan Cevher, “Matrix ALPS: Accelerated low rank and sparse matrix reconstruction”, IEEE SSP, 2012.
- Anastasios Kyrillidis and Volkan Cevher, “Combinatorial selection and least absolute shrinkage via the CLASH algorithm”, IEEE ISIT, 2012.
- Anastasios Kyrillidis, Gilles Puy and Volkan Cevher, “Hard thresholding with norm constraints”, IEEE ICASSP, 2012.
- Anastasios Kyrillidis and Volkan Cevher, “Recipes on hard thresholding methods”, 4th IEEE CAMSAP, 2011.
- Anastasios Kyrillidis and George. N. Karystinos, “Rank-deficient quadratic-form maximization over M -phase alphabet: Polynomial-complexity solvability and algorithmic developments”, IEEE ICASSP, 2011.

Journals

- Amir Kalev, Anastasios Kyrillidis, and Norbert M Linke, “Validating and certifying stabilizer states”, Physical Review A, 2019.
- Ya-Ping Hsieh, Yu-Chun Kao, Rabeeh Karimi Mahabadi, Alp Yurtsever, Anastasios Kyrillidis, and Volkan Cevher, “A non-Euclidean gradient descent framework for non-convex matrix factorization”, IEEE Transactions in Signal Processing, 2018.
- Dohyung Park, Anastasios Kyrillidis, Constantine Caramanis, and Sujay Sanghavi, “Finding low-rank solutions via non-convex matrix factorization, efficiently and provably”, SIAM Journal on Imaging Sciences (SIIMS), 2018.
- Anastasios Kyrillidis, Amir Kalev, Dohyung Park, Srinadh Bhojanapalli, Constantine Caramanis, and Sujay Sanghavi, “Provable compressed sensing quantum state tomography via non-convex methods”, npj Quantum Information 4.1 (2018): 36, 2018.
- Quoc Tran-Dinh, Anastasios Kyrillidis, and Volkan Cevher, “A single-phase, proximal path-following framework”, Mathematics of Operations Research, INFORMS, 2018.
- Hemant Tyagi, Anastasios Kyrillidis, Bernd Gärtner, and Andreas Krause, “Algorithms for learning sparse additive models with interactions in high dimensions”, IMA Information and Inference Journal, Springer, 2017.
- Luca Baldassarre, Nirav Bhan, Volkan Cevher, Anastasios Kyrillidis, and Siddhartha Satpathi “Group-sparse model selection: Hardness and relaxations”, IEEE Trans. on Information Theory, 2016. (Authors listed in alphabetical order.)
- Georgios Skoumas, Dieter Pfoser, Anastasios Kyrillidis and Timos Sellis, “Location estimation using crowdsourced spatial relations”, ACM Transactions on Spatial Algorithms and Systems, vol. 2, issue 2, 2016.
- Quoc Tran Dinh, Anastasios Kyrillidis and Volkan Cevher, “Composite self-concordant minimization”, Journal of Machine Learning Research (JMLR), 16(Mar):371-416, 2015.
- Michail Vlachos, Nikolaos Freris and Anastasios Kyrillidis, “Compressive mining: fast and optimal data mining in the compressed domain”, Very Large Data Bases (VLDB) Journal, Volume 24 Issue 1, February 2015.
- Quoc Tran-Dinh, Anastasios Kyrillidis and Volkan Cevher, “An inexact proximal path-following algorithm for constrained convex minimization”, SIAM Journal on Optimization (SIOPT), vol. 24, num. 4, p. 1718-1745, 2014.
- Anastasios Kyrillidis and George. N. Karystinos, “Fixed-rank Rayleigh quotient maximization by an M -PSK sequence”, IEEE Trans. on Communications, Volume:62, Issue:3, pages 961-975, 2014.
- Anastasios Kyrillidis and Volkan Cevher, “Matrix recipes for hard thresholding methods”, Journal of Mathematical Imaging and Vision (JMIV), April 2013, Springer.

- Nikolaos D. Sidiropoulos and Anastasios Kyrillidis, “Multi-way compressed sensing for sparse low rank tensors,” IEEE Signal Processing Letters, 19(11):757-760, Oct. 2012.

Book chapters

- Volkan Cevher, Sina Jafarpour and Anastasios Kyrillidis, “Linear inverse problems with norm and sparsity constraints,” in Practical Applications of Sparse Modeling, Sept. 2014, MIT Press. (Authors listed in alphabetical order.)
- Anastasios Kyrillidis, Luca Baldassarre, Marwa El-Halabi, Quoc Tran-Dinh and Volkan Cevher, “Structured sparsity: discrete and convex approaches”, in “Compressed sensing and its application”, Springer, 2014.

PREPRINTS

- Jose Antonio Lara Benitez, Zhiwei Zhang, and Anastasios Kyrillidis, “Momentum-inspired Low-Rank Coordinate Descent for Diagonally Constrained SDPs”, preprint - work in progress, 2020.
- Anastasios Kyrillidis, George Kollias, Amir Kalev, Lyle Kim, and Tayo Ajayi, “Twenty qubit quantum state tomography via momentum-inspired non-convex programming”, preprint - work in progress, 2020.
- John Chen, Cameron Wolfe, Zhao Li and Anastasios Kyrillidis, “Demon: Decaying momentum helps neural network training”, preprint - work in progress, 2020.
- Binhang Yuan, Cameron Wolfe, Chen Dun, Yuxin Tang, Anastasios Kyrillidis and Chris Jermaine, “Distributed Learning of Deep Neural Networks Using Independent Subnet Training”, work in progress, 2020.
- Vatsal Shah, Anastasios Kyrillidis and Sujay Sanghavi, “On the generalization of adaptive methods for overparameterized linear regression”, preprint - work in progress, 2019.
- Anastasios Kyrillidis, Moshe Vardi and Zhiwei Zhang, “On continuous local search for hybrid SAT solving”, preprint - work in progress, 2020.
- Yibo Zhang, Rajiv Khanna, Anastasios Kyrillidis, and Oluwasanmi Koyejo, “Bayesian coresets: Revisiting the nonconvex optimization perspective”, preprint - work in progress, 2020.
- John Chen, Qihan Wang, and Anastasios Kyrillidis, “Mitigating Deep Double Descent by Concatenating Inputs”, preprint - work in progress, 2020.
- John Chen Samarth Sinha, and Anastasios Kyrillidis, “ImCLR: Implicit Contrastive Learning for Image Classification”, preprint - work in progress, 2020.
- Anastasios Kyrillidis, Anshumali Shrivastava, Moshe Vardi, and Zhiwei Zhang, “Solving Hybrid Boolean Constraints in Continuous Space via Fourier Expansions”, preprint - work in progress, 2020.
- Chen Dun, Cameron Wolfe, and Anastasios Kyrillidis, “ResIST: Layer-Wise Decomposition of ResNets for Distributed Training”, preprint - work in progress, 2020.

INVITED

TALKS/WORKSHOPS

- Distributed learning of deep neural networks using independent subnet training
 - INFORMS (virtual), November, 2020.
 - Intel, USA, September, 2020.
 - Technical University of Crete, Greece, August, 2020.
 - Google, USA, June, 2020.
- Finding low-rank solutions, efficiently and provably
 - Department of Mathematics Seminar Series, University of Houston, Houston, USA, November, 2019.
- Low-rank regularization and solution uniqueness in over-parameterized matrix sensing
 - Data Science Symposium, Texas A&M, College Station, USA, September, 2019.
 - INFORMS, Seattle, USA, October 2019.
- A new approximation technique for quadratic form maximization over discrete sets on the unit sphere
 - CAAM Seminar Series, Rice University, Houston, USA, April, 2019.
- Three concepts in ML that require rethinking: Implicit regularization, over-parameterization, and momentum acceleration
 - INFORMS, Arizona, USA, October 2018.
 - Data Science Conference, Houston, USA, September 2018.
- Rethinking algorithms in Data Science: Scaling up optimization using non-convexity, provably
 - IBM T.J. Watson Research Center, New York, USA, January, 2018.

- Rutgers University, New Jersey, USA, March, 2017.
- University of Massachusetts, Amherst, USA, March, 2017.
- University of Alberta, Edmonton, Canada, March, 2017.
- Carnegie Mellon University, Pittsburgh, USA, February, 2017.
- Rice University, Houston, USA, February, 2017.
- Ohio State University, Columbus, USA, February, 2017.
- Maryland University, Washington DC, USA, February, 2017.
- Aalto University, Helsinki, Finland, February, 2017.
- Max-Planck Symposium, Berlin, Germany, January, 2017.
- Purdue University, West Lafayette, USA, January, 2017.
- Northwestern University, Chicago, USA, January, 2017.
- Waterloo University, Waterloo, Canada, January, 2017.
- Temple University, Philadelphia, USA, December, 2016.
- *Finding low-rank solutions via the Burer-Monteiro approach, efficiently and provably*
 - Seminaire d'analyse numerique, Section de mathematiques, University of Geneva, Switzerland, December, 2016.
 - Systems, Information, Learning and Optimization (SILO) Seminar, Wisconsin Institute for Discovery, USA, November, 2016.
 - Departments of Mathematics and Computer Science, University of Maryland, USA, November, 2016.
 - Colorado School of Mines, USA, October, 2016.
 - University of Colorado Boulder, USA, October, 2016.
 - Digital Technology Center (DTC) Seminar, Minneapolis, USA, October, 2016.
 - Allerton Conference, Urbana Champaign, USA, September, 2016.
- *Composite self-concordant minimization and extensions to path-following schemes*
 - UT Simons Seminar, Austin, USA, September, 2015.
 - International Symposium on Mathematical Programming (ISMP), Pittsburgh, USA, July, 2015.
 - ENS, Paris, France, Mar. 2014.
- *Scalable solutions to some "hard" problems via self-concordance*, EcoCloud Annual Event, Lausanne, Switzerland, June 2014.
- *Sparse simplex projections for portfolio optimization*, 2013 IEEE GlobalSIP Symposium on Signal and Information Processing in Finance and Economics, Austin, TX US, Dec. 2013.
- *A proximal Newton framework for composite minimization: Graph learning without Cholesky decompositions and matrix inversions*, Signal Processing with Adaptive Sparse Structured Representations (SPARS) Workshop, Lausanne, Switzerland, July 2013.
- *Randomized low-memory singular value projection*, CECAM Workshop on Tensor Network Algorithms in Computational Physics and Numerical Analysis, Zurich, Switzerland, May 2013.
- *Sparse projections onto the simplex*, Discrete Optimization in Machine Learning (DISCML) NIPS Workshop, Lake Tahoe, CA US, Dec. 2012.
- *Scalable and accurate learning of sparse Gaussian Markov random fields*, Machine Learning Workshop (MLWS), Lausanne, Switzerland, Nov. 2012.
- *Fast proximal algorithms for self-concordant minimization with application to sparse graph selection*, Asilomar conference on signals, systems and computers, Pacific Grove, CA US, Nov. 2012.
- *Combinatorial selection and least absolute shrinkage via the CLASH algorithm*
 - Sparse representation and low rank approximation NIPS Workshop, Sierra Nevada, Spain, Dec. 2011.
 - IMA annual program, High dimensional phenomena workshop, Minneapolis, MN US, Sept. 2011.
- *Recipes for Hard Thresholding Methods*, Signal processing with adaptive sparse structured representations (SPARS), Edinburgh, UK, June 2011.
- *Polynomial complexity computation of the M-phase vector that maximizes a rank-deficient quadratic form*, Discrete Optimization (DisOpt) PhD Seminars, EPFL, Nov. 2010.

Area Chair for:

International Conference on Machine Learning (ICML) - 2019, 2020, 2021.
Neuronal Information Processing Systems (NeurIPS) - 2019, 2020.
International Conference on Learning Representations (ICLR) - 2021.

Reviewer/PC member for:

International Conference on Machine Learning (ICML), Neuronal Inference and Processing Systems (NeuIPS), Artificial Intelligence and Statistics (AISTATS), American Association on Artificial Interlligence (AAAI), IEEE International Conference on Communications (ICC), IEEE Transactions on Signal Processing (TSP), IEEE Transactions on Information Theory (TIT), Mathematics of Operation Research (Math OR), Mathematical Programming Journal, SIAM Journal on Matrix Analysis and Applications, IMA Information and Inference.