

Soledad Villar

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Education

- 2017 **PhD in Mathematics**, *University of Texas at Austin*, United States.
Supervisor: Rachel Ward
Dissertation: Relax, descend and certify: optimization techniques for typically tractable data problems
- 2012 **Master of Science in Mathematics**, *Universidad de la República*, Uruguay.
Supervisor: Gonzalo Tornaría
Dissertation: Gross formula on heights and special values of L -series.
- 2010 **Bachelor in Mathematics**, *Universidad de la República*, Uruguay.
Supervisor: Gonzalo Tornaría
Project: Pell curves cryptography and generalizations.
- 2010 **Bachelor in Informatics Engineering**, *Universidad Católica del Uruguay*, Uruguay.

Academic positions

- 2017-2019 **Moore-Sloan Research Fellow**, *Center for Data Science*, New York University, New York City, USA.
- 2017-2019 **Collaboration Scientist**, *Algorithms and Geometry Simons Collaboration*, Simons Foundation, New York City, USA.
- Fall 2017 **Research Fellow**, *Bridging Continuous and Discrete Optimization*, Simons Institute, University of California, Berkeley, USA.
Mentor: Benjamin Recht

Publications and preprints

Journal papers (accepted)

- 2016 **Clustering Gaussian mixtures by semidefinite programming**, *D. G. Mixon, S. Villar and R. Ward*, *Information and Inference: A Journal of the IMA*, 6(4):389–415, 2017.
- 2015 **Probably certifiably correct k-means clustering**, *T. Iguchi, D. G. Mixon, J. Peterson and S. Villar*, *Mathematical Programming*, 165(2):605–642, 2017.

Journal papers (under revision)

- 2017 **Monte Carlo approximation certificates for k-means clustering**, *D. G. Mixon, S. Villar*, (submitted), Preprint available as arXiv:1710.00956.
- 2016 **A polynomial-time relaxation of the Gromov-Hausdorff distance**, *S. Villar, A. S. Bandeira, A. J. Blumberg and R. Ward*, (submitted), Preprint available as arXiv:1610.05214.

Conference papers

- 2017 **A Note on Learning Algorithms for Quadratic Assignment with Graph Neural Networks**, *A. Nowak, S. Villar, A. S. Bandeira and J. Bruna*, *International Conference on Machine Learning (ICML)* 2017.
- 2017 **Projected power iteration for network alignment**, *E. Onaran and S. Villar*, In *Wavelets and Sparsity XVII*, volume 10394, pages 103941C. *International Society for Optics and Photonics*, 2017.

- 2017 **Manifold optimization for k -means clustering**, *T. Carson, D. Mixon, S. Villar and R. Ward*, In Sampling Theory and Applications (SampTA), 2017 International Conference on, pages 73–77. IEEE, 2017.
- 2015 **Relax, no need to round: Integrality of clustering formulations**, *P. Awasthi, A. S. Bandeira, M. Charikar, R. Krishnaswamy, S. Villar and R. Ward*, In Proceedings of the 2015 Conference on Innovations in Theoretical Computer Science, pages 191–200. ACM, 2015..

Preprints

- 2018 **SUNLayer: Stable denoising with generative networks**, *D. G. Mixon and S. Villar*, (submitted, preprint available upon request).
- 2015 **On the tightness of an SDP relaxation of k means clustering**, *T. Iguchi, D. G. Mixon, J. Peterson and S. Villar*, (preprint), ArXiv:1505.04778.

Fellowships and awards

- 2017 **Speaker at UT Commencement Ceremony**, presented remarks representing the graduating class of PhD students at University of Texas at Austin.
- 2016-2017 **University Graduate Continuing Fellowship**, Office of Graduate Studies, University of Texas at Austin.
- 2014 **Frank Gerth III Graduate Excellence Award**, Department of Mathematics, University of Texas at Austin.
- 2012-2013 **Fulbright Grant for Graduate Studies**.
- 2011 **ANII Fellowship to conduct masters studies in mathematics**, National agency of research, Uruguay.
- 2008 **IMPA Fellowship for summer school of mathematics**, IMPA, Rio de Janeiro, Brazil.
- 2006 **UCUDAL Excellence Fellowship**, Universidad Católica del Uruguay.
- 2004 **Fellowship “Dr. Carlos Eduardo Millies” to attend Bessie F. Lawrence International Summer Science Institute**, Weizmann Institute of Science, Israel.

Invited talks and presentations

- Feb 2018 **Center for Data Science lunch seminar**, New York University, USA.
Title: Gerrymandering and math.
- Jan 2018 **Microsoft Research**, Redmond, Washington, USA.
Title: Gromov-Hausdorff distance, semidefinite programming and deep learning.
- Dec 2017 **Uruguayan Colloquium of Mathematics**, Universidad de la República, Uruguay.
Title: Gromov-Hausdorff distance, semidefinite programming and deep learning.
- Dec 2017 **Young Researchers Workshop: new trends in Computational and Applied Mathematics**, Peking University, Beijing, China.
Title: Quadratic assignment in data models.
- Dec 2017 **Minisymposium on Spectral Graph Theory and Optimization**, University of California, Berkeley, USA.
Title: Spectral clustering, non-negative factorization, and manifold optimization.
- Nov 2017 **Mathematical Data Science Seminar**, Department of Mathematics, University of Tennessee, Knoxville, USA.
Title: k -means clustering with optimization.
- Sep 2017 **Topology, Geometry and Data Seminar**, Department of Mathematics, Ohio State University, Columbus, Ohio, USA.
Title: Quadratic assignment on general data models.

- Sep 2017 **Machine Learning Lunch Seminar**, Electrical and Computer Engineering Department, Ohio State University, Columbus, Ohio, USA.
Title: Quadratic assignment on general data models.
- Sep 2017 **IMA Data Science Seminar**, Institute of Mathematics and its Applications, University of Minnesota Twin Cities, Minneapolis, USA.
Title: Quadratic assignment on general data models.
- Ago 2017 **SPIE Wavelets and Sparsity**, San Diego, USA.
Title: Projected power iteration for network alignment.
- Jul 2017 **Foundation of Computational Mathematics**, Barcelona, Spain.
Title: A polynomial-time relaxation of the Gromov-Hausdorff distance.
- Jul 2017 **Approximation Theory and Function Spaces Workshop**, Centre de Recerca Matemàtica, Barcelona, Spain.
Title: Clustering subgaussian mixtures by semidefinite programming.
- Oct 2016 **Applied Harmonic Analysis, Massive Data Sets, Machine Learning, and Signal Processing**, Oaxaca, Mexico.
Title: Clustering subgaussian mixtures by semidefinite programming.
- Sep 2016 **Information Theory Workshop**, Cambridge University, UK.
Title: Clustering subgaussian mixtures by semidefinite programming.
- May 2016 **SIAM Imaging**, Albuquerque, New Mexico, USA.
Title: A semidefinite relaxation for computing distances between metric spaces.
- Apr 2016 **MIT Applied Mathematics Seminar**, MIT, Cambridge, USA.
Title: Efficient global solutions to k -means clustering via semidefinite relaxation.
- Mar 2015 **AMS Sectional Meeting**, Michigan State University, East Lansing, USA.
Title: Convex optimization for clustering problems.
- Sep 2014 **IDeAS seminar**, Princeton University, Princeton, USA.
Title: Integrality of clustering formulations.
- Dec 2012 **Uruguayan Colloquium of Mathematics**, Universidad de la República, Uruguay.
Title: Cryptography and elliptic curves.
- Jun 2012 **Number Theory Regional Meeting**, Universidad Nacional de Córdoba, Argentina.
Title: The Rankin-Selberg method on L -functions.
- Nov 2011 **Number Theory Regional Meeting**, Universidad de Buenos Aires, Argentina.
Title: Dimension formulas of modular forms spaces.

Teaching experience

Instructor

- 2012 **Universidad de la República, Engineering School, Uruguay.**
Instructor of Calculus I
- 2011 **Universidad de la Católica del Uruguay, Electrical Engineering, Uruguay.**
Instructor of Linear Algebra and Discrete Mathematics

Teaching assistant

- 2011-2014 **University of Texas at Austin, Department of Mathematics.**
Courses:
- Differential equations and linear algebra.
 - From numbers to chaos.
 - Introduction to mathematics.
 - Calculus of complex variables.

- Integral calculus.
- Differential calculus.
- Differential equations and linear algebra.

2008-2012 **Universidad de la República, Department of Mathematics, Uruguay.**

Courses:

- Mathematics for life sciences (BA in Biology, Biochemistry, Geography).
- Linear algebra for Mathematics majors.
- Introduction to programming in Haskell.
- Introduction to programming in Python.
- General topology.

2006-2012 **Mathematical Olympiads (Uruguay).**

I was involved in Mathematical Olympiads since I was 12 years old. After I graduated from high school I worked as a volunteer for the Uruguayan Mathematical Olympiads. I participated as a trainer and a jury for the National Mathematical Olympics. I have conducted problem solving seminars for high school students and teachers.

Software development and industry projects

2016 - **Project: *Todo epsilon suma.***

My research blog on math, coding and data visualization solevillar.github.io

2010 - 2011 **Project: *Elliptic curves rank and random matrices.***

This is a project to study elliptic curves rank and its relation with random matrices theory. I programmed algorithms that calculated generalized theta series from lattices using cython.

2009 - 2010 **Project: *Analysis of coding and encryption algorithms.***

This project was held in the framework of an joint venture between ANTEL (an Uruguayan telecommunications company) and Universidad de la República. The aim of this project was to study the theoretical and practical security of the telecommunication networks of ANTEL.