ISMAEL MENDOZA

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EDUCATION

University of Michigan *Ann Arbor, MI*
PhD Physics and Scientific Computing Candidate, **GPA: 4.00** *Expected June 2024*

Stanford University *Stanford, CA*
MS Computer Science, **GPA: 3.74** *September 2018 - June 2019*

- **Research in Statistics and Cosmology**: "Olber's Paradox Revisited – Effects of Overlapping Sources on Cosmic Shear Estimation: Statistical Sensitivity and Pixel-Noise Bias"

BS Physics with Honors — Minor in Statistics, **GPA: 3.86** *September 2014 - June 2018*

- **Honors Thesis**: "No escape: light waves in AdS" (Link: `https://purl.stanford.edu/vf208qp2190`)

RESEARCH EXPERIENCE

Probabilistic Modeling with Machine Learning in Cosmology *University of Michigan, MI*
Advisor: Jeffrey Regier (Statistics) *October 2019 – Present*

- Developing a probabilistic framework to measure visually overlapping (blended) galaxies in state-of-the-art astronomical surveys like LSST.
- Building a generative model of galaxy images using variational autoencoders and normalizing flows.
- Designed and coded pipeline for training and validation of machine learning algorithms using `pytorch-lightning`, as well as how to test them on astronomical survey images.

BlendingToolKit *University of Michigan, MI*
Advisor: Camille Avestruz (Physics) *June 2020 – Present*

- Maintainer of the *BlendingToolKit*, a software tool kit for evaluating performance metrics for detection, deblending and measurement algorithms, applied to images of blended galaxies.
- Key infrastructure project for the Blending Working group of LSST DESC.

Computational Cosmology *University of Michigan, MI*
Advisor: Camille Avestruz (Cosmology) *September 2019 – Present*

- Using dark matter halo catalogs based on N-body simulations to tie together their dynamical history and snapshot properties.
- Created pipeline to easily extract dark matter halo present-day properties, merger tree information, and subhalo information for a random subset of haloes at fixed mass.
- Designed and programmed statistical model to predict present-day dark matter halo properties from its accretion histories.

Observational Cosmology and Data Analysis *Stanford, CA*
Advisor: Patricia Burchat (Cosmology) *June 2015 – April 2021*

- Developed a statistical framework for weak gravitational lensing that provides a comprehensive analysis of shape measurement noise bias for blended galaxies.
- Assessed the impact of blending on cosmic shear estimation for several astronomical surveys.
- arXiv version of the paper is available and currently undergoing review for submission to the Journal of Cosmology and Astrophysics (JCAP).

Biostatistics *Stanford, CA*
Advisor: Julia Palacios (Statistics and Biomedical Data Science) *September 2018 – June 2019*

- Implemented efficient algorithms for calculating the likelihood of phylogenetic trees simulated from coalescent models.

- Developed Bayesian statistical framework to calculate the probability of correct classification between two different population size histories for large sample sizes and loci.

Convex Optimization *Lausanne, Switzerland*
Advisor: Nisheeth Vishnoi (Theoretical Computer Science) *June 2018 – September 2018*

- Participated in Summer@EPFL CS program at the École polytechnique fédérale de Lausanne (EPFL).
- Designed and executed a project at interface of optimization, cosmology, and Riemannian geometry.
- Developed manifold optimization algorithms to measure galaxy shapes from surface brightness profiles.
- Used non-convex optimization techniques to mathematically show the high efficiency of my algorithm.

General Relativity and Field Theory Honors Thesis *Stanford, CA*
Advisor: Eva Silverstein (Cosmology) *June 2017 – June 2018*

- Developed a framework for understanding scattering processes in manifolds by combining insights from quantum scattering theory, differential geometry, and partial differential equations.
- Applied framework to successfully resolve paradox of light waves traveling in Anti-de Sitter space.
- Simulated complex wave scattering processes using Mathematica.
- Presented work as my undergraduate Honors Thesis to the Stanford Physics Undergraduate Committee and at the Stanford Symposium of Undergraduate Research (SURPS).

TEACHING EXPERIENCE

Statistics Teaching Assistant at the University of Michigan *Ann Arbor, MI*

- **Courses:**
  - Statistics 507: Data Science and Analytics using Python *August 2020 – December 2020*
- Designed and graded weekly programming assignments.
- Planned and executed a `kaggle` competition as their final project.

Physics Teaching Assistant at the University of Michigan *Ann Arbor, MI*

- **Courses:**
  - Physics 136: Physics for the Life Sciences Laboratory I *September 2019 – December 2019*
  - Physics 141: Elementary Laboratory I *January 2020 – April 2020*
- Guided students through a series of physics experiments including analysis of their measurements.

Physics Teaching Assistant at Stanford University *Stanford, CA*

- **Courses:**
  - Physics 21: Mechanics, Fluids, and Heat *September 2018 – December 2018*
  - Physics 70: Foundations of Modern Physics *September 2017 – December 2017*
- Designed and graded weekly problem sets, quizzes, and exams.
- Lead weekly problem-solving sessions aimed at reinforcing student's understanding of lecture.

EPASA: Tutored middle school student in math and English. *September 2016 – June 2018*
Habla: Tutored Stanford custodial staff in English 3 hours/week. *September 2014 – June 2018*

HONORS AND AWARDS

Stanford Undergraduate Advising and Research Major Grant: Grant recipient for research *2017*

Large Synoptic Survey Telescope Corporation Enabling Science Award: Grant recipient for research *2016*

45th International Physics Olympiad: Bronze Medalist *2014*

PROGRAMMING SKILLS

Python, C/C++, LaTeX, Mathematica, Unix shell, Git, R

PUBLICATIONS

Sanchez, J., Mendoza, I., Kirkby, D. P., & Burchat, P. R. (2021). *Effects of overlapping sources on cosmic shear estimation: Statistical sensitivity and pixel-noise bias.* arXiv preprint arXiv:2103.02078.

PRESENTATIONS

Connecting the Properties of Dark Matter Haloes with Their Growth, Ismael Mendoza, University of Michigan Clusters Group, Ann Arbor, MI. March 2021 (virtual)

Effects of overlapping sources on cosmic shear estimation: Statistical sensitivity and pixel-noise bias, Javier Sanchez & Ismael Mendoza, Collaboration-Wide Presentation for the Dark Energy Science Collaboration (DESC). February 2021 (virtual)

Bayesian Light Source Separator (BLISS), Ismael Mendoza, Dark Energy Science Collaboration (DESC) Summer 2020 Virtual Meeting Poster Session, Chicago, IL. July 2020 (virtual)

Blending ToolKit Tutorial, Ismael Mendoza, Dark Energy Science Collaboration (DESC) Summer 2020 Virtual Meeting, Chicago, IL. July 2020 (virtual)

The Blending Problem in Cosmology, Ismael Mendoza, Physics Graduate Student Symposium 2020, Ann Arbor, MI. July 2020 (virtual)

BlendingToolKit: Walkthrough and Future Plans, Ismael Mendoza, DESC Blending Working Group. July 2020 (virtual)