Kevin S. Bello Medina (Kevin Bello)

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Research Interests

I am broadly interested in Artificial Intelligence and Machine Learning. My research focuses on developing algorithms that are computationally and statistically efficient for various machine learning problems. *Specific Topics of Interest*: Combinatorial problems in machine learning, structured prediction, convex relaxations, high-dimensional statistics, fundamental limits, causal discovery, fairness, generative models.

Academic Positions

Joint Postdoctoral Fellow Sept. 2021 - present
University of Chicago (Booth School of Business) and
Carnegie Mellon University (Machine Learning Department)
Mentors: Bryon Aragam (UChicago) and Pradeep Ravikumar (CMU)

Education

Ph.D. in Computer Science Aug. 2016 - Aug. 2021
Purdue University, Indiana, USA
Thesis: "Structured Prediction: Statistical and Computational Guarantees in Learning and Inference"
Advisor: Jean Honorio

B.Sc. in Mechatronics Engineering (Robotics) Aug. 2009 - Dec. 2014
Universidad Nacional de Ingenieria, Lima, Peru
Summa Cum Laude

Honors and Awards

- **NSF Computing Innovation Fellowship**
  Prestigious award given by the Computing Research Association and
  Computing Community Consortium to support two-year postdoctoral positions 2021
- **Bilsland Dissertation Fellowship**
  Competitive award given to the most outstanding students at Purdue University 2021
- Travel award to attend NeurIPS 2018, 2019
- Grant to participate in the Machine Learning Summer School, Kyoto University 2015
- Highest accumulated GPA of my class, Universidad Nacional de Ingenieria 2014
- Peruvian Council of Science and Technology (Concytec) research grant 2013
- **Presidente Manuel Pardo y Lavalle Prize**
  Highest honor given to undergraduates at Universidad Nacional de Ingenieria 2012
- Grant to participate in the *1st Latin American Theoretical Informatics School*, University of Chile 2012

Publications

Preprints

[1] "A Thorough View of Exact Inference in Graphs from the Degree-4 Sum-of-Squares Hierarchy".
K. Bello, C. Ke, and J. Honorio.
Under review, 2021.

[2] "On the Fundamental Limits of Exact Inference in Structured Prediction".
H. Lee, **K. Bello**, and J. Honorio.
Under review, 2021.

[3] "Direct Learning with Guarantees of the Difference DAG Between Structural Equation Models".
A. Ghoshal, **K. Bello** and J. Honorio.
Under review, 2021.

Peer-reviewed Conferences

[4] "Inverse Reinforcement Learning in the Continuous Setting with Formal Guarantees".
G. Dexter, **K. Bello**, and J. Honorio.
Neural Information Processing Systems (NeurIPS), Canada, 2021.

[5] "A Le Cam Type Bound for Adversarial Learning and Applications".
K. Bello*, Q. Xu*, and J. Honorio.
IEEE International Symposium on Information Theory (ISIT), Australia, 2021.

[6] "Fairness Constraints can Help Exact Inference in Structured Prediction".
K. Bello and J. Honorio.
Neural Information Processing Systems (NeurIPS), Canada, 2020.

[7] "Minimax Bounds for Structured Prediction Based on Factor Graphs".
K. Bello, A. Ghoshal and J. Honorio.
International Conference on Artificial Intelligence and Statistics (AISTATS), Italy, 2020.

[8] "Exact Inference in Structured Prediction".
K. Bello and J. Honorio.
Neural Information Processing Systems (NeurIPS), Canada, 2019.

[9] "Learning Latent Variable Structured Prediction Models with Gaussian Perturbations".
K. Bello and J. Honorio.
Neural Information Processing Systems (NeurIPS), Canada, 2018.

[10] "Computationally and Statistically Efficient Learning of Bayes Nets Using Path Queries".
K. Bello and J. Honorio.
Neural Information Processing Systems (NeurIPS), Canada, 2018.

[11] "Improving Topic Coherence Using Entity Extraction Denoising".
R. Cardenas, **K. Bello**, A. Coronado and E. Villota.
The Prague Bulletin of Mathematical Linguistics, Czech Republic, 2018.

[12] "Panorama of the Market Demand for Mechanical Engineers in South American Countries".
R. Cardenas, **K. Bello**, A. Valle, E. Villota and A. Coronado.
ASME-IMECE, USA, 2015.

Conference Presentations and Invited Talks

[1] "Exact Inference in Structured Prediction"
Research Experience for Peruvian Undergraduates CS Seminar. Virtual, July 2021.

[2] "Bayesian Network Learning with Path Queries"
IEEE EMBS, Universidad Nacional de Ingenieria. Virtual, June 2021.

[3] "Exact Inference in Graphs and its Structural Properties"
Carnegie Mellon University. Virtual, April 2021. (Host: Pradeep Ravikumar).

[4] "Exact Inference in Graphs and its Structural Properties"
Massachusetts Institute of Technology CSAIL. Virtual, April 2021. (Host: David Sontag).

[5] "Exact Inference in Graphs and its Structural Properties"
Massachusetts Institute of Technology CBMM. Virtual, April 2021. (Host: Tomaso Poggio).

[6] "Exact Inference in Graphs"
Peru's 3rd Symposium of Deep Learning. Virtual, January 2021.

[7] "Fairness Constraints can Help Exact Inference in Structured Prediction"
Neural Information Processing Systems (NeurIPS). Virtual, December 2020.

[8] "Ph.D. Research Experience"
TECHSUYO Accelerating digital transformation in Peru. Virtual, October 2020.

[9] "Minimax Bounds for Structured Prediction Based on Factor Graphs"
Artificial Intelligence and Statistics (AISTATS). Virtual, August 2020.

[10] "Exact Inference in Structured Prediction"
Neural Information Processing Systems (NeurIPS). Vancouver, December 2019.

[11] "Learning Latent Variable Structured Prediction Models with Gaussian Perturbations"
Neural Information Processing Systems (NeurIPS). Montreal, December 2018.

[12] "Computationally and Statistically Efficient Learning of Bayes Nets Using Path Queries"
Neural Information Processing Systems (NeurIPS). Montreal, December 2018.

[13] "Labor Market Demand Analysis for Engineering Majors in Peru Using Topic Modeling"
Machine Learning Summer School (MLSS). Kyoto, August 2015.

Professional Service

- Chair of the LXAI Workshop at ICML 2020.
- **Reviewer**:
  Conferences: ICLR 2022, AAAI 2022, NeurIPS 2021, ICML 2021, AISTATS 2021, ICLR 2021, NeurIPS 2020, IJCAI 2020, NeurIPS 2019.
  Journals: JMLR 2021, IEEE TPAMI 2020.

Research Experience

Research Assistant June 2017 - Aug. 2021
Department of Computer Science, Purdue University Advisor: *Jean Honorio*

- Analyzed the degree-4 sum-of-squares hierarchy for exact inference in graphs.
- Studied the effect of fairness constraints in exact inference for structured prediction.
- Analyzed information-theoretic bounds for adversarial learning.
- Derived lower bounds to characterize learnability of structured prediction models, specifically, factor graph models with unary and pairwise factors.
- Studied the sufficient conditions to perform exact inference in polynomial time for structured prediction trough the use of semidefinite programming relaxations.
- Developed a computationally efficient method for the learning of latent-variable structured prediction models under Gaussian perturbations, and studied its generalization properties by using PAC-Bayes and Rademacher complexity.
- Studied the learning of causal Bayesian networks by using path queries. A poly-time algorithm with polynomial sample complexity was proposed.

PhD Intern May 2020 - Aug. 2020
Facebook AI Supervisor: *Maxim Grechkin and Hao Ma*

- Studied backward compatible representations of Facebook content, i.e., explored how to reconstruct an *old* pre-trained embedding given a *new* pre-trained embedding from a more complex model.

PhD Intern May 2019 - Aug. 2019
Facebook AI Supervisor: *Yunlong He*

- Proposed domain-based metrics for a feature selection algorithm as part of the Ads Ranking team.

Teaching Experience

Teaching Assistant *Department of Computer Science, Purdue University*

- Data Mining and Machine Learning (CS 373) Spring 2021
- Statistical Machine Learning (CS 578) Fall 2020
- Data Structures and Algorithms (CS 251) Fall 2016, Spring 2017