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 Interests: Combinatorial problems in machine learning, structured prediction, convex relaxations, sample complexity analysis and generalization bounds, primal/dual witness, information-theoretic bounds, combinatorial optimization, causal Bayesian networks, fairness, generative models.

Education

August 2016 - August 2021 (Expected) **Purdue University**, Indiana, USA
Ph.D. Computer Science

August 2009 - December 2014 **Universidad Nacional de Ingenieria**, Lima, Peru
B.S. Mechatronics Engineering (Robotics). *Summa Cum Laude.*

Relevant Professional Experience

Research Assistant June 2017 - Present
Department of Computer Science, Purdue University Advisor: *Prof. 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.
- 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 - August 2020
Facebook AI Supervisor: *Maxim Grechkin and Hao Ma*

- As part of the AI integrity team, I analyzed backward compatible representations of Facebook content. That is, I explored how well one can produce an *old* pre-trained embedding given a *new* pre-trained embedding.

PhD Intern May 2019 - August 2019
Facebook Supervisor: *Yunlong He*

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

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

Publications

Preprints

1. **K. Bello**, C. Ke, J. Honorio. "A Thorough View of Exact Inference in Graphs from the Degree-4 Sum-of-Squares Hierarchy." Under review. 2021
2. H. Lee, **K. Bello**, J. Honorio. "On the Fundamental Limits of Exact Inference in Structured Prediction." Under review. 2021
3. G. Dexter, **K. Bello**, J. Honorio. "Inverse Reinforcement Learning in the Continuous Setting with Formal Guarantees." Under review. 2021
4. A. Ghoshal, **K. Bello** and J. Honorio. "Direct Estimation of Difference Between Structural Equation Models." Under review, 2021.

Peer-reviewed Conferences

5. **K. Bello***, Q. Xu* and J. Honorio. "A Le Cam Type Bound for Adversarial Learning and Applications." *IEEE International Symposium on Information Theory*, Australia, 2021.
6. **K. Bello** and J. Honorio. "Fairness Constraints can Help Exact Inference in Structured Prediction." In *Proceedings of the 34rd Annual Conference on Neural Information Processing Systems* (NeurIPS), Virtual, 2020.
7. **K. Bello**, A. Ghoshal and J. Honorio. "Minimax Bounds for Structured Prediction Based on Factor Graphs." In *Proceedings of the 23rd International Conference on Artificial Intelligence and Statistics* (AISTATS), Virtual, 2020.
8. **K. Bello** and J. Honorio. "Exact Inference in Structured Prediction." In *Proceedings of the 33rd Annual Conference on Neural Information Processing Systems* (NeurIPS), Canada, 2019.
9. **K. Bello** and J. Honorio. "Learning Latent Variable Structured Prediction Models with Gaussian Perturbations." In *Proceedings of the 32nd Annual Conference on Neural Information Processing Systems* (NeurIPS), Canada, 2018.
10. **K. Bello** and J. Honorio. "Computationally and Statistically Efficient Learning of Bayes Nets Using Path Queries." In *Proceedings of the 32nd Annual Conference on Neural Information Processing Systems* (NeurIPS), Canada, 2018.
11. R. Cardenas, **K. Bello**, A. Coronado and E. Villota. "Improving Topic Coherence Using Entity Extraction Denoising". *Proceedings of The Prague Bulletin of Mathematical Linguistics*, 2018.
12. R. Cardenas, **K. Bello**, A. Valle, E. Villota and A. Coronado. "Panorama of the Market Demand for Mechanical Engineers in South American Countries." Proceedings of the ASME-IMECE, USA, 2015.

Honors and Awards

- **Bilsland Dissertation Fellowship** (Highly competitive and prestigious award that is given only to the most outstanding students at Purdue University) 2021
- Travel award to attend NeurIPS 2018, 2019
- Kyoto University's grant to participate in the Machine Learning Summer School (MLSS) in Kyoto, Japan 2015
- Dean's list 2010 - 2014
- Honorable Mention (top 15), ACM ICPC, South America 2012, 2014
- Peruvian Council of Science and Technology grant to attend a summer course for programming olympiads 2013
- Ranked 35 out of 7500 participants in the Worldwide IEEExtreme Programming Competition 7.0 2013
- *"Presidente Manuel Pardo y Lavalle Prize"*. (Highest honor given to undergraduates at UNI, Lima, Peru) 2012
- University of Chile's grant to participate in the *1st Latin American Theoretical Informatics School* 2012
- 2nd Place in the national programming competition IEEExtreme - INTERCON, Peru 2012

Presentations

- Talk at MIT CSAIL hosted by Prof. David Sontag. Apr. 2021
- Talk at CMU hosted by Prof. Pradeep Ravikumar and Prof. Bryon Aragam. Apr. 2021
- Talk at Prof. Tomaso Poggio's Lab at MIT CBMM. Apr. 2021
- Talk at Peru's 3rd Symposium of Deep Learning. Jan. 2021
- Annual Conference on Neural Information Processing Systems (NeurIPS). Virtual Conference. Dec. 2020
  Fairness constraints can help exact inference in structured prediction.
- Talk at TECHSUYO Accelerating digital transformation in Peru: Silicon Valley Perspective. Oct. 2020
- Annual Conference on Artificial Intelligence and Statistics (AISTATS). Virtual Conference Aug. 2020
  Minimax Bounds for Structured Prediction Based on Factor Graphs.
- Annual Conference on Neural Information Processing Systems (NeurIPS). Vancouver, Canada. Dec. 2019
  Exact Inference in Structured Prediction.
- Annual Conference on Neural Information Processing Systems (NeurIPS). Montreal, Canada. Dec. 2018
  Learning latent variable structured prediction models with Gaussian perturbations.
- Annual Conference on Neural Information Processing Systems (NeurIPS). Montreal, Canada. Dec. 2018
  Computationally and statistically efficient learning of Bayes nets using path queries.
- Machine Learning Summer School (MLSS). Kyoto, Japan. Aug. 2015
  Labor Market Demand Analysis for Engineering Majors in Peru Using Shallow Parsing and Topic Modeling.

Professional Service

- Chair of the LXAI Workshop at ICML 2020.
- **Reviewer**: *Conferences*: NeurIPS'21, ICML'21, AISTATS'21, ICLR'21, NeurIPS'20, IJCAI'20, NeurIPS'19. *Journals*: IEEE TPAMI.

Other Activities

- **Machine Learning Summer School (MLSS)** Aug. - Sept. 2015
  Received Kyoto University's grant to participate in the MLSS in Kyoto, Japan. Some of the topics covered were: convex optimization, scalable machine learning, reinforcement learning, concentration inequalities, etc.
- **Researcher at Artificial Intelligence and Control Systems Laboratory (GISCIA)** 2013 - 2015
  Former president and member of the Artificial Intelligence and Control Systems Laboratory at Universidad Nacional de Ingenieria, Lima, Peru. Organized seminars to introduce research topics to undergraduate students.
- **Summer Course for Computer Science Olympiads** Jan. 2013
  Attended a three-week course about algorithms at Universidade Estadual de Campinas, Brasil. High-quality professors from Europe and South America gave lectures to the best university teams from South America.
- **1st Latin American Theoretical Informatics School (LATIN)** April 2012
  Received University of Chile's grant to participate in the 1st LATIN school in which were given lectures by professors from the Massachusetts Institute of Technology, Universitat Politecnica de Catalunya, and Universidad Nacional Autonoma de Mexico.

Relevant Courses

Purdue University (PhD level): Statistical machine learning, hands-on learning theory, deep learning, reinforcement learning, natural language processing, optimization, causality, data mining, algorithm design and analysis, data communication and computer networks.
Universidad Nacional de Ingenieria: Artificial intelligence, statistics and probability, linear algebra, multivariable calculus, digital image processing, numerical methods, digital and electronic circuits, multi-body dynamics, differential equations.

Course Projects

- Graph Neural Networks and Reinforcement Learning for the Traveling Salesman Problem Fall 2020
  Reinforcement Learning @ Purdue University
- RSNA Pneumonia Detection Challenge Fall 2018
  Deep Learning @ Purdue University
- Causal Effect Identification using Generative Adversarial Networks Fall 2017
  Causality @ Purdue University
- Automatic Parameter Tuning of Neural Networks using Reinforcement Learning Fall 2016
  Statistical Machine Learning @ Purdue University

Programming Languages & Software

Python, PyTorch, C/C++, MATLAB, Caffe2, TensorFlow, R, SQL, Apache Spark , HTML, LaTeX.