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: Structured prediction, analysis of sample complexity and generalization bounds, deep learning, causal Bayesian networks, fairness, generative models.

Education

August 2016 - December 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

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. Coded in PyTorch Lightning.

Research Assistant June 2017 - Present
Department of Computer Science, Purdue University Advisor: *Prof. Jean Honorio*
- 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. As a byproduct, an extension of Cheeguer's inequality was obtained.
- Developed a computationally efficient method for the learning of latent-variable structured prediction models under Gaussian perturbations, and studied generalization bounds using PAC-Bayes and Rademacher complexity.
- Proposed a polynomial-time algorithm for the learning of causal Bayesian networks using path queries, and also analyzed the sample complexity using concentration inequalities.

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. A general workflow was implemented in Python/Caffe2 to test different metrics.

Teaching Assistant August 2016 - May 2017
Department of Computer Science, Purdue University
- Delivered lab sessions, prepared homeworks and exams for undergraduate computer science courses.

Publications

1. **K. Bello** and J. Honorio. "Fairness Constraints can Help Exact Inference in Structured Prediction." Arxiv Preprint, 2020.
2. **K. Bello**, Q. Xu and J. Honorio. "Fundamental Limits of Adversarial Learning." Arxiv Preprint, 2020.
3. **K. Bello**, A. Ghoshal and J. Honorio. "Direct Estimation of Difference Between Structural Equation Models." Under review, 2020.
4. **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), Italy, 2020.
5. **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.
6. **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.

7. **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.
8. 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.
9. 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

- 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 Universidad Nacional de Ingenieria, 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

- Annual Conference on Artificial Intelligence and Statistics (AISTATS). Palermo, Italy. 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.

Course Projects

RSNA Pneumonia Detection Challenge Fall 2018

Deep Learning @ Purdue University

- The problem was a Kaggle competition about detection of pneumonia from chest radiographs. RetinaNet was used due to computational resources. Some small modifications to the architecture include: the use of P_2 in the Feature Pyramid Network backbone in order to capture smaller objects, and additional anchors. Coded using PyTorch.

Causal Effect Identification using Generative Adversarial Networks Fall 2017

Causality @ Purdue University

- Analyzed the use of Generative Adversarial Networks to directly model a Structural Causal Model. The causal functions were modeled in such a way that they induce a given observational distribution. Coded using PyTorch.

Automatic Parameter Tuning of Neural Networks using Reinforcement Learning Fall 2016

Statistical Machine Learning @ Purdue University

- Implemented an agent to autotune the parameters of a basic Convolutional Neural Network for the CIFAR-10 dataset. The correctness of the agent's implementations was tested using OpenAI's pendulum environment. Coded using TensorFlow.

Teaching Experience

Data structures and algorithms (CS 251), *Teaching Assistant, Purdue University* Fall 2016, Spring 2017

- Lectured two sections about basic principles of data structures and algorithms at the undergraduate level.

Other Activities

- **Reviewer**:
  Conferences: ICLR 2021, NeurIPS 2020, IJCAI 2020, NeurIPS 2019.
  Journals: IEEE TPAMI.

- **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, deep learning, optimization, causality, data mining, algorithm design and analysis, hands-on learning theory, 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.
Online courses: Neural networks, probabilistic graphical models, natural language processing, statistical inference.

Programming Languages & Software

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