

# Héctor Javier Hortúa

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**Citizenship:** Colombia

## Research interests

The research I am currently involved in consists of the application of Deep learning in several scientific disciplines and in real world-dataset, along with the study of probabilistic inference through Markov Chain Monte Carlo (MCMC) and Variational Inference (VI). More specifically, my research falls under two topics: First, the use of neural ensembles, Bayesian neural networks and Gaussian Processes for modelling uncertainties in Deep learning, which are crucial for making better decisions in real-world applications. Second, the implementation of alternative generalized divergences and Bijectors in VI in order to improve the inference processes, and be able to obtain well-calibrated neural networks. I have also worked on the robustness of Bayesian classifiers for detecting adversarial examples through Variational AutoEncoders or calibrated networks, and the implementation of stochastic neural networks for Object Detection in computer vision methods. Finally, I have built different end-to-end data science/ML projects starting from building an ML-focused strategy and progressing into model training, optimization, and productionalization using Google Cloud Platform.

## Education

<b>Universidad Nacional de Colombia</b> PhD in Physics	Bogotá, Colombia 04 2019
<b>Universidad Nacional de Colombia</b> MSc in Astrophysics	Bogotá, Colombia 07, 2011
<b>Universidad Nacional de Colombia</b> BA in Physics	Bogotá, Colombia 07, 2008

## Honors and

## scholarships

Laureate Distinction: Doctoral Thesis. Universidad Nacional de Colombia. 2020

Colciencias-Conv. 647, Doctorado Nacional Fellowship 2015

Meritorious Distinction: Master Thesis. Universidad Nacional de Colombia. 2011

## Internships

Romanian Institute of Science and Technology 2018-2019

Implement supervised and unsupervised techniques in Machine and Deep Learning, and the use of TensorFlow and Sonnet for building an end-to-end pipeline for big astrophysical dataset.

## Research experience

### **Postdoctoral Networking in Artificial Intelligence**

DAAD, Germany

2021

Initiative funded by the German Federal Ministry of Education and Research to scientific talents from all over the world a personalized gateway to the German AI research community.

### **Postdoctoral Research Scientist**

Romanian Institute of Science and Technology

2019-2020

Design and analysis of novel training algorithms for neural networks in deep learning, by applying notions of Riemannian optimization and differential geometry [RIST](#).

### **Argo project**

DeepRiemann - Riemannian Optimization Methods for Deep Learning project.  
POC 2014-2020

Argo is a library for deep learning algorithms based on TensorFlow and Sonnet. The library allows you to train different models (feed-forwards neural networks for regression and classification problems, autoencoders and variational autoencoders, Bayesian neural networks, Helmholtz machines, etc) by specifying their parameters as well as the network topologies in a configuration file. The models can then be trained in parallel in presence of multiple GPUs. The library is easy to expand for alternative models and training algorithms, as well as for different network topologies. [ARGO](#)

## Professional experience

### **Data Scientist at Dispell Magic Inc., Competitoor**

Dover, County of Kent, Delaware, USA

2021

Stays ahead of the Machine Learning needs by identifying opportunities for improvement modelling tools, processes or infrastructure; and working on workflow from data access, processing and modeling, to data visualization.

## Teaching experience

### **Teaching associate, Department of Basic Science (U. Los Libertadores)**

2011-2014

Physics and Maths

Relevant products: First Astrostatistics School: Bayesian Methods in Cosmology, held in U. Los Libertadores Bogotá D.C., Colombia. [Proceedings](#)

Relevant products: IAU Symposium 306: Statistical Challenges in 21st Cosmology [Cambridge University Press](#)

## Projects

### **Reliable Uncertainties for Bayesian Neural Networks using Alpha divergences**

Design new metrics and methods to determine the accuracy in prediction's neural models. Generalized divergences were implemented for different dataset.

*Results presented and published at ICML, Uncertainty and Robustness in Deep Learning, 2020.*

### **Accelerating MCMC algorithms through Bayesian Deep Networks**

New approach to accelerate MCMC techniques by adding at the top of the model the Neural network. It allows to include reliable parameter space parameter and be able to speed up the convergence.

*Results presented and published at NeurIPS, Machine Learning and Physical Sciences, 2020.*

### **Constraining the reionization history using Bayesian normalizing flows**

Apply Normalized flow in computer vision tasks. Additionally, implement uncertainties in Object detection models to obtain robust vision models. It can be apply to style transfer, segmentation and resolution images.

*Results presented and published at Machine Learning Sci.Tech , 2020. and ICLR 2020 workshop Fundamental Artificial Intelligence in science*

*For publications click [here](#).*

## **Conferences**

**Conference on Neural Information Processing Systems, NeurIPS**, Contribution: "Accelerating MCMC algorithms through Bayesian Deep Networks" virtual, 12 2020

**Joint Structures and Common Foundation of Statistical Physics, Information Geometry and Inference for Learning**, Contribution: "Calibrating BNNs with  $\alpha$ -divergences and Normalizing Flows", Les Houches, France, 07 2020

**Thirty-seventh International Conference on Machine Learning, ICML**, Contribution: "Reliable Uncertainties for Bayesian Neural Networks using  $\alpha$ -divergences", Virtual, 08 2020

**Eighth International Conference on Learning Representations, ICLR**, Contribution: "Parameters Estimation from the 21 cm signal using Variational Inference", Virtual, 05 2020

**Bayesian Deep Learning for Cosmology and Gravitational waves**, Contribution: "Constraining Cosmological Parameters from CMB maps using Neural Networks", Paris, France, 03 2020

**AICosmo2019: Artificial Intelligence Methods in Cosmology**, Contribution: "Estimation of Cosmological Parameters via ConvNets", Ascona, Switzerland, 06 2019

## **Certifications**

**TensorFlow Developer Certificate, Google** 01 2021

**Artificial Intelligence Technology Certificate, Huawei** 02 2021

Certificated courses	<b>Advanced Machine Learning on Google Cloud, Coursera</b>	02 2021
	<b>TensorFlow: Advanced Techniques, Coursera</b>	11 2020
	<b>Machine Learning with TF on GCP, Coursera</b>	02 2021
	<b>TensorFlow: Data and Deployment, Coursera</b>	11 2020
	<b>TensorFlow 2 for Deep Learning, Coursera</b>	10 2020
	<b>Advanced Data Science with IBM, Coursera</b>	06 2020
	<b>Learn SQL Basics for Data Science, Coursera</b>	08 2020
Scientific courses	<b>Transylvanian Machine Learning Summer School (TMLSS)</b>	02 2018
	<b>Microsoft Research Frontiers in Machine Learning</b>	07 2020
	<b>Quantum 2020, The Institute of Physics and IOP Publishing</b>	10 2020
Skills	<b>Programming</b>	
	Proficient in: Mathematica, C++, Python-libraries, scikit-learn, Tensorflow, Keras, TFProbability, Pandas ecosystem libraries, SQL, GIT, bash, DBeaver	
	Familiar with: Cuda, MPICH2, PyMC, Pystat, Apache Spark, MLlib, Sonnet, GCP, dataflow, docker	
	<b>OS</b>	
	Linux	
	<b>Editor</b>	
	L <sup>A</sup> T <sub>E</sub> X, Pycharm, Emacs	
	<b>Languages</b>	
	Spanish (mother tongue), English (Professional working)	