David Alvarez-Melis

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Research Interests

Machine Learning — Interpretability and transparency, domain adaptation, structured learning.

Optimization — Optimal transport, submodular optimization, semi-definite programming.

NLP — Low-resource machine translation, distributional semantics.

Education

2014 – *2019* (expected) **Massachusetts Institute of Technology**, Ph.D in Computer Science.
- Advisor: Tommi Jaakkola.
- Area: Machine Learning and Natural Language Processing.
- Minor: Mathematical Optimization
- Thesis: *Extending Optimal Transport to Structured Domains: Algorithms and Applications* (tentative title)

2011 – 2013 **Courant Institute, New York University**, New York, M.S. in Mathematics.
- Advisor: Dr. Mehryar Mohri.
- Thesis: *The Matrix Multiplicative Weights Algorithm for Domain Adaptation.*
- GPA: 3.975.

2006 – 2011 **Instituto Tecnologico Autonomo de Mexico**, Mexico City, B.S. (Licenciatura) in Applied Mathematics.
- Advisor: Dr. Carlos Bosch Giral
- Thesis: *The Lax-Milgram Theorem, Generalizations and Applications.*
- Grade: 9.74/10, highest honors, top 1% of class, valedictorian.

Relevant Graduate Coursework

MIT: 6.867 (ML), 6.883 (Adv. ML) NYU: NLP, Speech Reco., Math. Stats.

Research and Work Experience

2014 – **Research Assistant**, *MIT CSAIL*, Cambridge, MA, USA.
- Supervisor: Tommi Jaakkola.
- Projects: structured optimal transport, robustly interpretable machine learning, structured output decoding, word embeddings through random walks.

05 – 08/2018 **Research Intern**, *Microsoft Research*, New York, NY, USA.
- Mentors: Hanna Wallach, Jenn Wortman Vaughan, Hal Daumé III
- Project: Robust and Scalable Interpretability for Machine Learning.

05 – 08/2016 **Research Intern**, *Microsoft Research*, Redmond, WA, USA.
- Mentors: Scott Yih, Ming-Wei Chang, Kristina Toutanova, Chris Meek.
- Project: Multi-hop relation prediction for knowledge base question answering.

2013 – 2014 **Supplemental Researcher**, *IBM Research*, TJ Watson Center, NY, USA.
- Mentors: Michael Picheny & Ken Church (speech recognition group)
- Data mining, statistical modeling and machine learning for speech recognition data.
- Research on semi-supervised gender speaker identification with side information.

2009 – 2010 **Statistical Analyst**, *LasQuinceLetras Solutions*, Mexico City, Mexico.
- Designed and carried out statistical learning methods on large survey databases.
- Specialized on segmentation analysis, brand equity research and market trends.

2009 – 2010 **Research Assistant**, *ITAM*, Mexico City.
Under the supervision of Dr. Carlos Bosch. Projects: (i) the Lax-Milgram Theorem, (ii) Compiling a book with problems from the National Mathematical Olympiad.

Teaching Experience

Spring 2015 **Teaching Assistant**, *6.036: Introduction to Machine Learning*, MIT.

Spring 2013 **Adjunct Instructor (TA)**, *MATH-UA.121: Calculus I*, NYU.

Fall 2012 **Adjunct Instructor (TA)**, *MATH-UA.9: Algebra and Calculus*, NYU.

Spring 2012 **Grader**, *MATH-UA.326: Analysis II*, NYU.

2010 – 2011 **Teaching Assistant**, *Calculus I*, ITAM.

Spring 08/09 **Teaching Assistant**, *Economics III (Intermediate Microeconomics)*, ITAM.

Fellowships and Awards

2018 **Facebook Fellowship Finalist**, (30/800 applicants).

2018 **Hewlett Packard Graduate Fellowship**, One-term PhD award.

2018 **AI2 Key Scientific Challenges program award**, $10K unrestricted seed research funding.

2014 – 2018 **Fellowship for graduate studies abroad**, *CONACYT (Mexican Council of*
2011 – 2013 *Science and Technology)*.

March 2012 **Alumni Research Prize, Second Place**, *ITAM*, XVII Edition, Category: Undergraduate Thesis.

2012 – 2013 **Award for Graduate Studies Abroad**, *Mexican Ministry of Education*.

October 2011 **Sotero Prieto Prize, Second Place**, *Mexican Mathematical Society*, Yearly award for the best undergraduate theses in mathematics in the country.

2006 – 2009 **Academic Excellence Scholarship**, *ITAM*, For undergraduate studies.

Publications

Preprints

[1] **D. Alvarez-Melis**, S. Jegelka, and T. S. Jaakkola. "Towards Optimal Transport with Global Invariances". In Submission. 2018.

[2] **D. Alvarez-Melis** and T. Broderick. "A translation of "The characteristic function of a random phenomenon" by Bruno de Finetti". 2015.

Conference and Journal Publications

[3] **D. Alvarez-Melis** and T. S. Jaakkola. "Towards Robust Interpretability with Self-Explaining Neural Networks". In: *Advances in Neural Information Processing Systems (NIPS)*. 2018.

[4] **D. Alvarez-Melis** and T. S. Jaakkola. "Gromov-Wasserstein Alignment of Word Embedding Spaces". In: *Conference on Empirical Methods in Natural Language Processing (EMNLP)*. 2018. **(Oral Presentation).**

[5] **D. Alvarez-Melis**, T. S. Jaakkola, and S. Jegelka. "Structured Optimal Transport". In: *International Conference on Artificial Intelligence and Statistics (AISTATS)*. 2018. **(Oral Presentation)**.

[6] **D. Alvarez-Melis** and T. S. Jaakkola. "A causal framework for explaining the predictions of black-box sequence-to-sequence models". In: *Conference on Empirical Methods in Natural Language Processing (EMNLP)*. 2017.

[7] **D. Alvarez-Melis** and T. S. Jaakkola. "Tree-structured decoding with doubly-recurrent neural networks". In: *International Conference on Learning Representations (ICLR)*. 2017.

[8] **D. Alvarez-Melis** and M. Saveski. "Topic Modeling in Twitter: Aggregating Tweets by Conversations". In: *International AAAI Conference on Web and Social Media (ICWSM)*. 2016.

[9] T. B. Hashimoto, **D. Alvarez-Melis**, and T. S. Jaakkola. "Word Embeddings as Metric Recovery in Semantic Spaces". In: *Transactions of the Association for Computational Linguistics (TACL)* 4 (2016). **(Oral Presentation at ACL'16)**.

Refereed Workshop Contributions

[10] **D. Alvarez-Melis** and T. S. Jaakkola. "On the Robustness of Interpretability Methods". In: *Proceedings of the 2018 ICML Workshop in Human Interpretability in Machine Learning*. 2018. **(Oral Presentation).**

[11] G.-H. Lee, **D. Alvarez-Melis**, and T. S. Jaakkola. "Game-theoretic Interpretability for Temporal Modeling". In: *Fairness, Accountability and Transparency in Machine Learning*. 2018.

[12] **D. Alvarez-Melis** and J. Amores. "The Emotional GAN: Priming Adversarial Generation of Art with Emotion". In: *NIPS Workshop on Machine Learning for Creativity and Design*. 2017.

[13] **D. Alvarez-Melis**, T. S. Jaakkola, and S. Jegelka. "Structured Optimal Transport". In: *NIPS Workshop on Optimal Transport for Machine Learning*. 2017. **(Extended Oral Presentation).**

[14] T. B. Hashimoto, **D. Alvarez-Melis**, and T. S. Jaakkola. "Word, graph and manifold embedding from Markov processes". In: *NIPS Workshop on Nonparametric Methods for Large Scale Representation Learning*. 2015.

[15] C. Li, **D. Alvarez-Melis**, K. Xu, S. Jegelka, and S. Sra. "Distributional Adversarial Networks". In: *International Conference on Learning Representations (ICLR), Workshop Track*. 2017.

Theses

[16] **D. Alvarez-Melis**. "The Matrix Multiplicative Weights Algorithm for Domain Adaptation". M.S. Thesis. New York University, 2013.

[17] **D. Alvarez-Melis**. "El Teorema de Lax Milgram, Generalizaciones y Aplicaciones". B.Sc. Thesis. Instituto Tecnologico Autonomo de Mexico, 2011.

Professional Activities and Service

Reviewer ACL-IJCNLP 2015 (outstanding reviewer), IJCNLP 2017, ACL (2016 – 2018), TACL, UAI 2018, NIPS 2018 (reviewer award, registration waived), PLoS ONE, LXAI@NIPS 2018, AISTATS 2019.

Organizer **RIIAA** 2018 (student-run AI conference in Mexico City), `riiaa.org`.

Other **MIT EECS Graduate Admissions Committee**, 2017

Other **Orientation Co-Chair**, MIT Graduate Student Council.

Talks

Aug. 2018 *Neural Networks and Continuous Representations for NLP*, RIIAA 2018.

July 2018 *On The Robustness of Interpretability Methods*, WHI @ ICML 2018.

April 2018 *Interpretability in NLP*, Guest Lecture at CMU ECE-739: 'Security and Fairness of Deep Learning'.

April 2018 *Structured Optimal Transport*, AISTATS 2018.

Jan. 2018 *Learning with structured data: interpretability and optimal transport*, OpenAI.

Dec. 2017 *Interpretability for complex models in ML and NLP*, Systems That Learn @ MIT.

Dec. 2017 *Structured Optimal Transport*, NIPS 2017 Optimal Transport in ML Workshop.

Nov. 2017 *Interpretability for black-box seq-to-seq models*, CompLang Seminar, MIT.

Oct. 2015 *Word Embeddings and Neural Networks in NLP*, DeepLearn Seminar, MIT.

Professional Training

June 2017 **Machine Learning Summer School**, *Max-Planck-Institut*, Tübingen, Germany.

July 2014 **Regularization methods for Machine Learning**, *University of Genova*, Genova, PhD summer course taught by Lorenzo Rosasco and Francesca Odone.

Computer Skills

Languages Python, Bash, Java, R, C++, Lua

Libraries PyTorch, Torch, Theano, Scikit

Languages

Spanish Native

English Fluent *TOEFL (iBT) 113/120, IELTS 8.5/9, FCE, CAE both with Grade A.*

Italian Advanced *CILS-Tre Certificate.*

French Conversational *Mother's language, studied also at Alliance Française Bordeaux.*

German Basic *Completed levels A1 - A2 at Goethe Institut Mexiko.*

Dutch, Greek Beginner

Professional Memberships

AMS (2012–), SIAM (2013–), ACL (2016–), AAAS (2017–)

Other Interests

Languages, architecture (van der Rohe, Le Corbusier), classical guitar (Albéniz, Sor), Italian cinema, soccer.