

David Belanger

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Research Interests

- Deep Learning
- Graphical Models
- Structured Prediction
- Natural Language Processing
- Computer Vision

Education

University of Massachusetts Amherst

Computer Science (MS/PhD)

2011–Present

Advised by Andrew McCallum

Harvard University

Mathematics (BA)

2005–2009

Advised by Eric Dunham and Jim Rice

Experience

Information Extraction and Synthesis Lab, University of Massachusetts Amherst

Research Assistant

2011–Present

- Current work:
 - Structured prediction using deep energy-based models.
 - Deep learning for relation extraction, knowledge base QA, and text content recommendation.
- Earlier work:
 - Application of column generation to MAP inference in tree-structured graphical models
 - Technique for MAP inference in tree-structured graphical models subject to global soft constraints.
 - Message passing technique for corpus-wide structured prediction
 - Proximal gradient technique for variational-inference-based structured prediction
 - Fast learning of conditional random fields with combinatorial structure, such as bipartite matchings
- Ongoing:
 - Development of open source software packages for my work.
 - Participation in the 2013 and 2015 TAC Knowledge Base Population slot filling and cold start competitions
 - Organizer of the weekly Machine Learning and Friends Lunch

Google Research

Intern

Summer 2016

- Supervised by Dilip Krishnan and Bill Freeman
- Developed neural network module for differentiable warping of images given sparse control points. This enables image generation architectures that explicitly disentangle geometry from texture.

Microsoft Research New England

Intern

Summer 2014

- Supervised by Sham Kakade (now Prof. at University of Washington)
- Developed linear dynamical system model for text with highly-scalable learning algorithms.

Raytheon BBN Technologies

Associate Scientist

2009–2011

- Supervised by Prem Natarajan and Rohit Prasad
- Worked on DARPA-funded handwriting recognition and video analysis projects

Harvard School of Engineering and Applied Sciences

Undergraduate Research Assistant

2007-2009

- Supervised by Prof. Jim Rice (Harvard) and Prof. Eric Dunham (now Prof. at Stanford)
- Developed numerical methods for modeling earthquake ruptures occurring along fractal-shaped fault surfaces to help explore relationship between fault roughness spectrum and high frequency aspects of earthquake ground motion

MITACS Industrial Math Summer School, Simon Fraser University

Undergraduate Researcher

2008

- Developed medical image processing techniques for automatically detecting shape and color irregularities in histology slides of placenta tissue

Publications

PDFs of all papers are available at people.cs.umass.edu/~belanger/

Conference.....

- *Face Synthesis from Facial Identity Features*. Forrester Cole, David Belanger, Dilip Krishnan, Aaron Sarna, Inbar Mosseri, William T. Freeman. Arxiv Preprint, 2017.
- *Chains of Reasoning over Entities, Relations, and Text using Recurrent Neural Networks*. Rajarshi Das, Arvind Neelakantan, David Belanger, Andrew McCallum. Conference of the European Chapter of the Association for Computational Linguistics, 2017.
- *Structured Prediction Energy Networks*. David Belanger and Andrew McCallum. International Conference on Machine Learning, 2016.
- *Multilingual Relation Extraction using Compositional Universal Schema*. Pat Verga, David Belanger, Emma Strubell, Ben Roth, Andrew McCallum. Conference of the North American Chapter of the Association for Computational Linguistics, 2016.
- *Ask the GRU: Multi-task Learning for Deep Text Recommendations*. Trapit Bansal, David Belanger, Andrew McCallum. ACM Recommender Systems Conference, 2016.
- *Bethe Learning of Conditional Random Fields via MAP Decoding*. Kui Tang, Nick Ruozi, David Belanger, Tony Jebara. Artificial Intelligence and Statistics, 2016.
- *Bethe Projections for Non-Local Inference*. Luke Vilnis*, David Belanger*, Dan Sheldon, Andrew McCallum. Uncertainty in Artificial Intelligence, 2015. (* equal contribution)
- *A Linear Dynamical System Model for Text*. David Belanger and Sham Kakade. International Conference on Machine Learning, 2015.
- *Message Passing for Soft Constraint Dual Decomposition*. David Belanger, Alexandre Passos, Sebastian Riedel, Andrew McCallum. Uncertainty in Artificial Intelligence, 2014.
- *Learning Soft Linear Constraints with Application to Citation Field Extraction*. Sam Anzroot, Alexandre Passos, David Belanger, Andrew McCallum. Meeting of the Association of Computational Linguistics, 2014.
- *Marginal Inference in MRFs using Frank-Wolfe*. David Belanger, Dan Sheldon, Andrew McCallum. Neural Information Processing Systems Workshop on Greedy Algorithms, Frank-Wolfe, and Friends - A Modern Perspective, 2013.

- *Universal Schema for Slot Filling and Cold Start: UMass IESL at TACKBP 2013* Sameer Singh, Limin Yao, David Belanger, Ari Kobren, Sam Anzaroot, Mike Wick, Alexandre Passos, Harshal Pandya, Jinho Choi, Brian Martin, Andrew McCallum. Text Analysis Conference, 2013.
- *MAP Inference in Chains using Column Generation*. David Belanger*, Alexandre Passos*, Sebastian Riedel, Andrew McCallum. Neural Information Processing Systems 2012. (*equal contribution)
- *Baseline Dependent Percentile Features for Offline Arabic Handwriting Recognition*. Pradeep Natarajan, David Belanger, Rohit Prasad, Matin Kamali, Krishna Subramanian, Prem Natarajan. International Conference of Document Analysis and Retrieval 2011.
- *Consensus Network Based Hypothesis Combination for Arabic Offline Handwriting Recognition*. Rohit Prasad, Matin Kamali, David Belanger, Antti-Veikko Rosti, Spyros Matsoukas, Prem Natarajan. International Conference on Pattern Recognition, 2010.
- *Dynamic Rupture on Rough Faults and Production of High-Frequency Radiation*. David Belanger and Eric M. Dunham. American Geophysical Union Fall 2008 Meeting.

Journal.....

- *Earthquake Ruptures with Strongly Rate-Weakening Friction and off-Fault Plasticity, 2: Nonplanar Faults*. Eric M. Dunham, David Belanger, Lin Cong, and Jeremy Kozdon. Bulletin of the Seismological Society of America, 101(5), 2308-2322.
- *Earthquake Ruptures with Strongly Rate-Weakening Friction and off-Fault Plasticity, 1: Planar Faults*. Eric M. Dunham, David Belanger, Lin Cong, and Jeremy E. Kozdon. Bulletin of the Seismological Society of America, 101(5), 2296-2307.

Book Chapter.....

- *Earthquake Ruptures on Rough Faults*. Eric M. Dunham, David Belanger, Lin Cong, and Jeremy E. Kozdon. Multiscale and Multiphysics Processes in Geomechanics, Springer Series in Geomechanics and Geoengineering, pp. 145-148.

Open Source Software

2016: TORCH-UTIL: deep NLP in torch

- Available at github.com/davidBelanger/torch-util

2016: SPEN: code for Structured Prediction Energy Networks (ICML 2016).

- Available at github.com/davidBelanger/SPEN

2015: TEXTLDS: code for Linear Dynamical Systems for Text (ICML 2015).

- Available at github.com/davidBelanger/TextLDS

2011-Present: FACTORIE toolkit for machine learning, NLP, and graphical models:

- Available at github.com/factorie/factorie

Awards

2013: Yahoo Accomplishments in Search and Mining Award

2012: NSF Graduate Research Fellowship Runner Up

2012: Phaal Curry Monster Award, Brick Lane Curry House NYC. For eating extremely spicy curry in less than 30 minutes.

Talks

Oct. 2016: Google Brain

Jun. 2016: International Conference on Machine Learning
Dec. 2015: NIPS Extreme Classification Workshop
Dec. 2015: Invited Talk at Google Cambridge
July. 2015: International Conference on Machine Learning
Nov. 2014: UMass Undergraduate NLP Class Guest Lecture on Word Embeddings
Sep. 2014: UMass Machine Learning and Friends Seminar Series
Dec. 2013: NIPS Workshop on Greedy Algorithms, Frank-Wolfe, and Friends
Nov. 2013: UMass Graduate NLP Class Guest Lecture on Dual Decomposition
Oct. 2013: Columbia University Machine Learning and NLP Seminar
Sep. 2012: UMass Machine Learning and Friends Seminar Series
June. 2012: ICML Workshop on Inferring: Interactions between Inference and Learning

Programming Languages

- Advanced: Python, Lua, MATLAB, Scala
- Proficient: C, C++, Java