Christopher L. Dean

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Education

Massachusetts Institute of Technology (MIT), Cambridge, MA — Expected Spring 2022
Ph.D. Electrical Engineering and Computer Science
Thesis: Lightweight Data Fusion and Bayesian Nonparametric Mixtures
Adviser: Senior Research Scientist John W. Fisher III

Massachusetts Institute of Technology (MIT), Cambridge, MA — Spring 2015
S.M. Electrical Engineering and Computer Science
Thesis: Efficient MCMC Inference for Remote Sensing of Emission Sources
Adviser: Senior Research Scientist John W. Fisher III

The Ohio State University (OSU), Columbus, OH — Fall 2012
B.S. Computer Science and Engineering, *Summa Cum Laude with Honors Research*
Thesis: The Value of Delayed Information in Tracking with Distributed Sensor Networks
Adviser: Associate Professor Emre Ertin

Research Interests

Interpretable Machine Learning · Probabilistic Models · Bayesian Non-parametric Methods · Data Fusion
· Sampling Methods · Deep Learning · Active Learning · Computer Vision · Natural Language Processing

Research Experience

MIT Computer Science and Artificial Intelligence Laboratory — Fall 2013 - Present
Research Assistant: Design interpretable probabilistic graphical models and sampling-based methods for scalable Bayesian inference and data fusion. Apply these techniques to a variety of problem domains and application areas, including topic discovery in visual environments, nuclear monitoring and verification, estimating granular rates of electricity access in developing countries, detecting and localizing sources of gaseous emissions, and quantifying occupancy from low-level motion sensors. Create and maintain Python libraries and code repositories, organize and lead internal reading groups, and mentor junior researchers.

OSU Department of Electrical and Computer Engineering — January - December 2012
Undergraduate Research Assistant: Investigated sensor fusion and different sensor management approaches for Bayesian filtering and inference. Developed a framework for optimizing tracker performance through scheduling sensor measurements across time and space. Applied and validated techniques on a synthetic sensor network for object tracking using an Extended Kalman Filter.

Industry Experience

Apple • Siri Speech Team — Summer 2017
Intern: Modeling and software development for a novel language-modeling system feature.

Google • Google Photos Team — Summer 2016
Intern: Modeling and software development for a novel system feature.

Systems & Technology Research — Summer 2015
Intern: Developed a Bayesian non-parametric error model for image registration to ground-truth imagery; designed a sampling-based inference procedure to fuse data from multiple sources.

MIT Lincoln Laboratory   January - August 2013

    Co-op: Implemented object tracking for an aircraft collision avoidance system, designed experiments to ensure compliance with existing protocols, and produced sensing module documentation.

MIT Lincoln Laboratory   Summer 2011

    Intern: Implemented dynamic spectrum access for pairs of communicating software-defined radio nodes, enabling detection of interference and automatic relocation to other frequency bands.

Publications

"Lightweight data fusion: Learning sufficient statistics with neural networks for efficient inference." Christopher L. Dean, Stephen J. Lee, Jason Pacheco, and John W. Fisher III. *Under review by the Thirty-fifth Conference on Neural and Information Processing Systems (NeurIPS)*, 2021.

"Lightweight data fusion with conjugate mappings." Christopher L. Dean, Stephen J. Lee, Jason Pacheco, and John W. Fisher III. *arXiv preprint arXiv:2011.10607*, 2020.

"Efficient MCMC inference for remote sensing of emission sources." Christopher L. Dean. *S.M. Thesis, Massachusetts Institute of Technology*, Cambridge, MA, June 2015.

"The value of delayed information in tracking with distributed sensor networks." Christopher L. Dean. *B.S. Honors Thesis, The Ohio State University*, Columbus, OH, December 2012.

"Student Perspectives on Learning through Developing Software for the Real World." Christopher L. Dean, Thomas D. Lynch, and Rajiv Ramnath. *IEEE Frontiers in Education Conference*, Rapid City, SD, October 2011.

Working Papers

"A Dirichlet process primer." Christopher L. Dean and John W. Fisher III.

"Bayesian nonparametric mixtures for multimodal data." Christopher L. Dean and John W. Fisher III.

"How probabilistic electricity demand forecasts can expedite universal access to reliable electricity." Stephen J. Lee, Dhruv Suri, Priyanshi Somani, Christopher L. Dean, Giuseppe Montesano, Claudio Pregagnoli, Jason Pacheco, Robert Stoner, Ignacio J. Pérez-Arriaga, John W. Fisher III, Jay Taneja.

"Lightweight data fusion with learned sufficient statistics." Christopher L. Dean, Stephen J. Lee, Jason Pacheco, and John W. Fisher III.

"Probabilistic forecasts of county-level electricity demand data in Africa." Stephen J. Lee, Christopher L. Dean, Dhruv Suri, Priyanshi Somani, Giuseppe Montesano, Claudio Pregagnoli, Jason Pacheco, Robert Stoner, Ignacio J. Pérez-Arriaga, John W. Fisher III, Jay Taneja.

Presentations

Lightweight data fusion with conjugate mappings. Annual Workshop, Consortium for Enabling Technologies and Innovation, October 2020.

Lightweight data fusion for monitoring and verification. Thrust Area Review Meeting, Consortium for Verification Technologies, Ann Arbor, MI, March 2019.

Nonlinear dispersion modeling using CPAB transformations. University Program Review, Consortium for Verification Technologies, Ann Arbor, MI, June 2018.

Inferring electrification in developing nations via hierarchical beta models of multimodal observations (poster). New England Machine Learning Day, Microsoft Research New England, Cambridge, MA, May 2018.

An efficient nonlinear dispersion model using continuous-piecewise-affine-based transformations. Annual Workshop, Consortium for Verification Technologies, Ann Arbor, MI, November 2017.

Multimodal multiscale data fusion in spatial processes using the hierarchical beta model (poster). Annual Workshop, Consortium for Verification Technologies, Ann Arbor, MI, November 2017.

Remote sensing of emission sources via multi-flight data fusion. CSAIL Research Highlights, Computer Science and Artificial Intelligence Laboratory, MIT, Cambridge, MA, November 2016.

Efficient MCMC inference for remote sensing of emission sources (poster). Masterworks, Department of Electrical Engineering and Computer Science, MIT, Cambridge, MA, April 2015.

Bayesian inference of gas emission sources from airborne concentration measurements. Workshop, Multidisciplinary University Research Initiative on Bayesian Nonparametrics, Cambridge, MA, September 2014.

Honors & Awards

Irwin Mark Jacobs and Joan Klein Jacobs Presidential Fellowship, MIT	2013
Undergraduate Research Scholarship, OSU College of Engineering	2012
Warren G. and James M. Elliott Engineering Scholarship, OSU College of Engineering	2011, 2012
Crowe Horwath Scholarship, OSU Department of Computer Science and Engineering	2011
TechTomorrow Scholarship, TechColumbus	2010

Leadership, Mentoring, and Teaching

MIT Undergraduate Research Opportunities Program   Summer 2020 - Present

Supervisor, Spring 2021: led a freshman undergraduate student in a project focused on lightweight data fusion and data analysis in Python. Led to development of object-oriented regression code for count-based data.

Supervisor, Summer 2020: led an undergraduate student in a project focused on extracting features from video streams that are used for occupancy quantification in a probabilistic data fusion system.

Sensing, Learning, and Inference Group   Fall 2017 - Present

Organizer, Remote Working Workshop, Spring 2021 - Present: Coordinated and ran semi-weekly workshop to faciliate graduate student interaction and technical knowledge transfer while working remotely.

Mentor, Fall 2017 - Present: assist junior graduate students entering the Sensing, Learning, and Inference group (Principal Investigator: Senior Research Scientist John W. Fisher III). Created a course of readings and feedback prompts to expedite technical orientation and understanding of probabilistic models, exponential families, Bayesian methods, and sampling-based inference.

Consortium for Enabling Technologies and Innovation ● 2020 Summer School   August 2020

Lecturer: Co-taught session on Bayesian modeling and inference, focusing on sampling-based inference and Bayesian nonparametric methods. Developed interactive demos using Google Colab notebooks and a custom-built software library to provide hands-on experience with Dirichlet process and hierarchical Dirichlet process mixture models.

MIT Computer Science and Artificial Intelligence Laboratory ● Reading Groups   Spring - Fall 2018

Organizer, Bayesian Deep Learning Reading Group, Fall 2018: Organized and led the reading group covering deep learning models and training procedures, generative deep learning, deep learning with graphical models, and uncertainty quantification. Explored applications to computer vision and natural language processing.

Organizer, Information Planning Reading Group, Spring 2018: Organized and led the reading group covering information-theoretic quantities and their estimation, submodularity, active learning, optimal Bayesian experimental design, and Bayesian optimization. Explored applications to sensor networks and motion planning.

MIT Department of Electrical Engineering and Computer Science   Spring 2016

Teaching Assistant, 6.555 Biomedical Signal and Image Processing: held weekly recitations and hands-on lab sessions. Developed additional instructor materials and co-designed a novel medical image registration laboratory assignment. Instructor: Senior Lecturer Julie Greenberg.

Additional Qualifications

Programming: Python, TensorFlow, MATLAB. Emphasis on object-oriented design of machine learning software.

Software: Pip/Poetry/PyEnv, Git/Github, MacOS, Linux/Unix, Docker, Singularity, and SLURM workflows.