Ian Connick Covert

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Education

University of Washington — Seattle, WA
Ph.D. in Computer Science (Machine Learning) — *Expected December 2022*

Columbia University — New York, NY
BA in Computer Science, BA in Math/Statistics; GPA: 4.00; Summa Cum Laude; Phi Beta Kappa — *May 2017*

French American International High School — San Francisco, CA
International Baccalaureate (IB), Bilingual in French — *June 2013*

Experience

University of Washington — Seattle, WA
Graduate Student Researcher (supervised by Su-In Lee) — *January 2019-Present*

- Developed new tools for explaining predictions from black-box ML models. Derived approximation algorithms for Shapley value-based methods to enable uncertainty analysis and faster convergence.
- Unified a broad class of model explanation methods (26 prior works) and derived their shared foundations in game theory and information theory.
- Investigated feature selection approaches for deep learning models and adapted a differentiable feature selection approach to a genetic profiling problem (spatial transcriptomics with fluorescence in situ hybridization).

Google Brain — Mountain View, CA
Research Intern (supervised by Jiening Zhan, Ming Jack Po) — *June 2018-March 2019*

- Created deep learning models for automatic seizure detection from EEG data. Trained large convolutional and recurrent models, as well as a new topologically-aware architecture based on graph neural networks (GNNs).
- Led our team's efforts in creating model interpretability solutions. Adapted several algorithms to work with EEG data, proposed novel visualizations, and presented results internally as well as to our partner institution.

University of Washington — Seattle, WA
Graduate Student Researcher (supervised by Emily Fox) — *September 2017-December 2018*

- Developed algorithms to enable nonlinear Granger causality discovery with deep learning models.
- Proposed a regime-switching time series model based on deep learning with hidden Markov switching dynamics.

Goldman Sachs — New York, NY
IB Strategist Summer Analyst (supervised by Ketan Vyas, Joey Allcock) — *June 2016-August 2016*

- Conducted research on credit risk pricing for corporate counterparties with illiquid credit default swaps.
- Built a prototype application for data-driven share allocation in equity issuance processes.

Columbia University — New York, NY
Undergraduate Student Researcher (supervised by Liam Paninski) — *February 2016-May 2017*

- Designed a machine learning pipeline to extract neuron structure and activation from 3D calcium imaging videos.

Société Générale — New York, NY
Global Markets Summer Analyst (supervised by Bruno Braizinha) — *June 2015-August 2015*

- Collaborated with the fixed income research team to create pricing models for exotic interest rate derivatives.
- Developed a tool to quantify historical richness in the swaption market through volatility smile expression.

Open-Source Software

SAGE (github.com/iancovert/sage)

- Shapley additive global importance (SAGE), a game-theoretic global explanation method.

Neural-GC (github.com/iancovert/Neural-GC)

- Granger causality discovery using neural networks (MLPs, RNNs, LSTMs).

Shapley Regression (github.com/iancovert/shapley-regression)

- Practical Shapley value estimation via linear regression, with convergence detection and uncertainty estimation.

FastSHAP (github.com/iancovert/fastshap)

- An amortized approach to Shapley value estimation for large deep learning models.

Removal-Explanations (github.com/iancovert/removal-explanations)

- A lightweight implementation for removal-based explanations, a class representing 26 existing methods.

Publications

Neil Jethani*, Mukund Sudarshan*, **Ian Covert***, Su-In Lee, Rajesh Ranganath. "FastSHAP: Real-Time Shapley Value Estimation." *International Conference on Learning Representations (ICLR) 2022.* [link]

Ian Covert, Scott Lundberg, Su-In Lee. "Explaining by Removing: A Unified Framework for Model Explanation." *Journal of Machine Learning Research (JMLR) 2021.* [link]

Alex Tank*, **Ian Covert***, Nicholas Foti, Ali Shojaie, Emily Fox. "Neural Granger Causality." *Transactions on Pattern Analysis and Machine Intelligence (TPAMI) 2021.* [link]

Ian Covert, Su-In Lee. "Improving KernelSHAP: Practical Shapley Value Estimation via Linear Regression." *Artificial Intelligence and Statistics (AISTATS) 2020.* [link]

Ian Covert, Scott Lundberg, Su-In Lee. "Feature Removal Is A Unifying Principle For Model Explanation Methods." *NeurIPS Machine Learning Retrospectives, Surveys & Meta-Analyses (ML-RSA) Workshop 2020.* [link]

Ian Covert, Scott Lundberg, Su-In Lee. "Understanding Global Feature Contributions With Additive Importance Measures." *Neural Information Processing Systems (NeurIPS) 2020.* [link]

Ian Covert, Uygar Sümbül, Su-In Lee. "Deep Unsupervised Feature Selection." *Preprint (2018).* [link]

Ian Covert, Scott Lundberg, Su-In Lee. "Shapley Feature Utility." *Machine Learning in Computational Biology (MLCB) Workshop 2019.* [link]

Ian Covert, Uygar Sümbül, Su-In Lee. "Principal Genes Selection." *Machine Learning in Computational Biology (MLCB) Workshop 2019.* [link]

Ian Covert, Balu Krishnan, Imad Njam, Jiening Zhan, Matthew Shore, John Hixson, Ming Jack Po. "Temporal Graph Convolutional Networks for Automatic Seizure Detection." *Machine Learning for Healthcare (MLHC) 2019.* [link]

Jiening Zhan, Hector Yee, **Ian Covert**, Jiang Wu, Albee Ling, Matthew Shore, Eric Teasley, Rebecca Davies, Tiffany Kung, Justin Tansuwan, John Hixson and Ming Jack Po. "EEG Seizure Detection via Deep Neural Networks: Application and Interpretation." *NeurIPS Machine Learning for Health (ML4H) Workshop 2018.*

Alex Tank, **Ian Covert**, Nicholas Foti, Ali Shojaie, Emily Fox. "An Interpretable and Sparse Neural Network Model for Nonlinear Granger Causality Discovery." *NeurIPS Time Series Workshop 2017.* [link]

Awards and Honors

- Outstanding Reviewer (NeurIPS 2021, ICLR 2021, ICML 2020)
- PhD Fellowship Recipient (Princeton University, UIUC, UMass Amherst)
- Computer Science Award for Academic Excellence, Columbia University (2017)
- Summa Cum Laude, Columbia University (2017)
- Phi Beta Kappa, Columbia University (2017)
- Presidential Scholar Nominee (2013)
- President's Award for Academic Excellence (2013)