

Chun-Hao Chang

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Overview I'm interested in Applied ML Research. My PhD's works are about Machine Learning in **Interpretability (XAI)**, **Robustness**, and applied reinforcement learning in **Healthcare**. I interned in Google Cloud on **Anomaly Detection**, Microsoft, and Facebook on **Causal** Ads ranking. I was a software engineer for 2 years.

Education

- **Ph.D.**, Dept. of *Computer Science*, University of Toronto *Feb. 2018 – Present*
 - **M.S.**, Dept. of *Computer Science*, University of Toronto *Sep. 2016 – Jan. 2018*
 - **B.S.**, Dept. of *Electrical Engineering and Life Science*, National Taiwan University *Sep. 2010 – June. 2015*
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Main Research Works

- **[Interpretability, Healthcare] Extracting Clinician's Goals by What-if Interpretable Modeling** [link](#)
Submitted to 2022 AISTATS
Chun-Hao Chang, George Alexandru Adam, Rich Caruana, Anna Goldenberg
TLDR: We extract clinicians' treatment goals by interpretable GAM modeling and what-if reasoning
 - Recovered clinicians' treatment goals for hypotensive patients in a real-world ICU data.
 - Modeled the treatment reward by the future counterfactual outcomes combined with an interpretable model - Generalized Additive Model (GAM).
 - The reward matches several clinical guidelines while previous linear model often contradicts them.
- **[Interpretability] NODE-GAM: Neural Generalized Additive Model for Interpretable Deep Learning** [link](#)
Submitted to 2022 ICLR
Chun-Hao Chang, Rich Caruana, Anna Goldenberg
TLDR: We develop a deep-learning version of Generalized Additive Model (GAM) and GA^2M .
 - Proposed a new deep-learning version of Generalized Additive Model (GAM) and GA^2M - an interpretable model class. Our models have higher accuracy than traditional GAMs on large datasets.
 - Demonstrated our deep-learning GAM is interpretable.
 - When labeled data is limited, our model outperforms other GAMs by self-supervised pretraining.
- **[Interpretability] How Interpretable and Trustworthy are GAMs?** [link](#)
Published in 2021 SIGKDD (Conference on Knowledge Discovery and Data Mining)
Chun-Hao Chang, Sarah Tan, Ben Lengerich, Anna Goldenberg, Rich Caruana
TLDR: We compared total 9 different GAMs and showed which GAM is more trustworthy.
 - Compared total 9 kinds of inherently explainable models (Generalized Additive Models, GAMs) in terms of human explainability, inductive biases and performances across multiple real-world datasets.
 - Found GAMs with high feature sparsity (only using a few variables to make predictions) tend to hide patterns in the data and be unfair to rare subpopulations.
 - Found inductive bias plays a crucial role in model explanations and tree-based GAMs are recommended for their low feature sparsity and high data fidelity which make them more trustworthy.
- **[Robustness] Towards robust imaging model by counterfactual generation and adversarial generation** [link](#)
Published in 2021 CVPR
Chun-Hao Chang, George Alexandru Adam, Anna Goldenberg
TLDR: We proposed two data augmentations to make our models robust to data distribution shifts.
 - Proposed counterfactual and adversarial data augmentations to make imaging models robust to spurious correlation that may not hold in test time.

- Improved both generalization accuracy and out-of-class detection in multiple challenging datasets whose distributions differ from the training distributions.
- **[Robustness, Healthcare] Hidden Risks of Machine Learning Applied to Healthcare: Unintended Feedback Loops Between Models and Future Data Causing Model Degradation** [link](#)
Published in *2020 MLHC Machine Learning for Healthcare Conference*
George Alexandru Adam, **Chun-Hao Kingsley Chang**, Benjamin Haibe-Kains, Anna Goldenberg
TLDR: We characterize a feedback loop problem that clinicians changing their decisions based on an imperfect ML system that changes the future data distribution.
 - Introduced the feedback loop problem that the future data are corrupted by human interventions caused by model's predictions; If continually updated from new data, models degrade almost exponentially.
 - Proposed various sample removal techniques to minimize the effects of the feedback loop.
- **[Interpretability] Explaining Image Classifiers by Counterfactual Generation** [link](#)
Published in *2019 ICLR International Conference on Learning Representations*
Chun-Hao Chang, Elliot Creager, Anna Goldenberg, David Duvenaud
TLDR: We propose using generative models to ask counterfactual questions to interpret a black-box model.
 - Proposed a novel framework that explains neural network decisions by efficiently searching for important features that respect the distribution of the input data by generative model.
 - Our method produces more compact and relevant pixels of explanations with fewer artifacts; demonstrated our method's superiority over several baselines quantitatively on ImageNet.
- **[Healthcare] Dynamic Measurement Scheduling for Events Forecasting by Deep RL** [link](#)
Published in *2019 ICML International Conference of Machine Learning*
Chun-Hao Chang*, Mingjie Mai*, Anna Goldenberg
TLDR: We propose a reinforcement learning approach to better allocate healthcare resources for measurements.
 - Designed an automatic diagnostic machine in the hospital to prioritize the measurements of patients by Deep Q network (DQN).
 - To handle the large combinatorial action spaces (2^{40}) in the multi-action setting, we developed a sequential action approach to learn it more efficiently; we show it outperforms other baselines.
 - Applied to a real-world clinical ICU dataset (MIMIC3) and increase 3 times informative gain or reduce 31% measurement costs compared to physicians.

Main Work Experience

- **Student Researcher**, Google Cloud AI team *Aug. 2021 – Jan. 2022*
Host: Jinsung Yoon
 - **Research Intern**, Microsoft Research AI team *Jun. 2019 – Sep. 2019*
Host: Rich Caruana
 - **PhD Machine Learning Intern**, Ads Ranking team, Facebook UK *Jun. 2018 – Aug. 2018*
 - Modeled counterfactual inference of the ads data to measure lift effects of ads exposure on users
 - Visualized and analyzed the data and removed the outliers using SQL scripts and C++ programming.
 - Investigated various causal approach such as nearest neighbor, causal trees and multi-task learning.
 - **Machine Learning Teaching Assistant**, University of Toronto / Vector Institute *6 times from 2017-2020*
Vector Certificate, CSC412 Neural Networks, CSC411 Machine Learning, CSC311 Intro to ML
 - **Software Engineer**, Political Warfare Bureau, R.O.C. Armed Forces *Aug. 2015 – July 2016*
 - Designed and programmed a search engine (ElasticSearch) with distributed computation to speed up.
 - Led a team of 5 people including technical and non-technical personnel (designer/front-end engineers)
 - **Android Engineer Intern**, TripNotice Inc. *Jan. 2014 – Mar. 2015*
 - Independently designed and implemented a trip-booking Android app (TripNotice) in Java from scratch.
 - **Conference Reviewers** (ICLR, NeurIPS, ICML, CVPR, AISTATS) *8 times from 2018*
 - **Appraiser on UofT CS Graduate Admissions** *2019, 2020, 2021*
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Miscellaneous

- **MiniMBA course completion, Sickkids-GMCA miniMBA program** *Jan 2017*
Took a 12-week class for MBA classes and won the 2nd place out of 12 groups in the final presentation.
 - **Service:** Activities director, Toronto Taiwanese Graduate Student Association *2017, 2020*
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References

- **Anna Goldenberg**, Associate Professor
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Relationship: PhD advisor
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- **Rich Caruana**, Senior Principal Researcher
Microsoft Research
Relationship: intern host and a research collaborator
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- **David Duvenaud**, Assistant Professor
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- **Marzyeh Ghassemi**, Assistant Professor
MIT in Electrical Engineering and Computer Science (EECS) and Institute for Medical Engineering (IMES)
Relationship: the thesis committee member
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