LAWRENCE CHILLRUD

Ph.D. Student

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CV Date of Preparation: 10/2022

Interests

Machine Learning; Artificial Intelligence; Interpretability; Explainability; Robustness; Alignment; Deep Learning; Dimensionality Reduction; Optimization; Precision Medicine; Healthcare; Biomedical Imaging; Environmental Health; Public Health; Environmental Epidemiology; Cancer; COVID-19; Air Pollution; Climate Change

Education

9/2022 – Present **Ph.D. in Electrical Engineering** *Evanston, IL*
Northwestern University, McCormick School of Engineering
Advisors: Lee Cooper, Ph.D. and Aggelos Katsaggelos, Ph.D.
Specialization in Signals and Systems

9/2021 – 5/2022 **Post-baccalaureate Scholar** *New York, NY*
Columbia University, School of Professional Studies

9/2016 – 5/2020 **B.A. in Computer Science** *New York, NY*
Columbia University, Columbia College
Specialization in Intelligent Systems

Research

9/2022 – Present **Graduate Student Research Fellow** *Chicago, IL*
Northwestern University, Feinberg School of Medicine
Department of Pathology
Advisor: Lee Cooper, Ph.D.

Working in the Computational and Integrative Pathology Group to develop machine learning methods that can assist in studying and treating various kinds of cancer. Current projects include:

- Weakly-supervised learning / multiple instance learning for survival analysis of a cohort of patients suffering from gliomas of varying severity

9/2022 – Present **Graduate Student Research Fellow** *Evanston, IL*
Northwestern University, McCormick School of Engineering
Department of Electrical & Computer Engineering
Advisor: Aggelos Katsaggelos, Ph.D.

Working in the Image and Video Processing Lab to develop machine learning methods for the analysis of biomedical image data. Current projects include:

- Training and validating deep learning models for image segmentation of brain tumors

Research (ctd)

10/2020 – 8/2022 **Senior Programmer** *New York, NY*
Columbia University, Mailman School of Public Health
Department of Environmental Health Sciences
Advisor: Marianthi-Anna Kioumourtzoglou, Sc.D.

Worked in makLab to develop interpretable machine learning methods for assessing complex mixtures of environmental exposures. Main project tailored Principal Component Pursuit (PCP), a dimensionality reduction technique from computer vision, for pattern recognition in environmental epidemiology. Other work included:

- Investigated convex & non-convex approaches to matrix decomposition, dim reduction
- Leveraged Gaussian processes to design faster cross-validated grid searches
- Developed Bayesian non-parametric ensemble model for uncertainty characterization
- Conducted extensive code reviews for academic papers (reviewed over 9,000 lines)
- Cleaned, visualized & documented public health datasets for various research questions
- Aided in writing, editing of scientific papers & abstracts, presented work at conferences
- Explored methods for source apportionment: PCP, PCA, Autoencoders, Factor Analysis
- Built environmental / epidemiological health models and analyses

6/2020 – 10/2020 **EHS Research Assistant** *New York, NY*
Columbia University, Mailman School of Public Health
Department of Environmental Health Sciences
Advisor: Marianthi-Anna Kioumourtzoglou, Sc.D.

Worked in makLab to develop interpretable machine learning methods for assessing complex mixtures of environmental exposures.

- Adapted & extended Principal Component Pursuit for environmental mixtures data
- Benchmarked PCP's computational efficiency, interrogated its mathematical foundations
- Developed novel, user-friendly R packages for implementation of environmental PCP
- Designed & ran synthetic & applied experiments to assess PCP's statistical performance

6/2020 – 10/2020 **NLP Research Assistant** *New York, NY*
Columbia University
Department of Computer Science
Advisor: Kathleen McKeown, Ph.D.

Worked to develop, train, and validate an automatic fact-checking model for combating misinformation online surrounding COVID-19 & climate-change.

- Worked with transformer architectures (BERT), few-shot learning, claim detection, named entity recognition, unsupervised data augmentation, transfer learning for fact-checking
- Built a COVID-19-specific dataset to train and test RoBERTa-based fact-checking model
- Scraped millions of online news articles for COVID-19 claims, mapped to scientific papers
- Wrote IRB protocol to receive approval for human annotators to tag fact-checking dataset
- Implemented & maintained user-friendly annotation interface to facilitate annotations
- Assisted in writing, editing of scientific paper detailing our novel fact-checking pipeline

Publications

Under Review

7. Rowland ST, Parks RM, **Chillrud LG**, Paisley J, Henze D, Milly G, Fiore A, Liu J, Coull B, Kioumourtzoglou M-A. Characterizing Predictive Uncertainty of Annual $PM_{2.5}$ Concentrations in the Contiguous United States, 2010 – 2015. Submitted 2022.

6. Wang G, **Chillrud LG**, Harwood KR, Ananthram A, Subbiah M, McKeown KR. Check-COVID: A Corpus and Task for Fact-Checking COVID-19 Misinformation with Scientific Evidence. Under review 2022.

5. Cerna-Turoff I, **Chillrud LG**, Rudolph KE, Casey JA. Standards in responsibly sharing cohort data for transparency and reproducibility: response to The Young Lives study. Under review 2022.

4. Tao RH, **Chillrud LG**, Nunez Y, Rowland ST, Boehme AK, Yan J, Goldsmith J, Kioumourtzoglou M-A. Applying Principal Component Pursuit to investigate the association between source-specific fine particulate matter and myocardial infarction hospitalizations in New York City. Under review 2022.

Peer-Reviewed

3. Gibson EA, Zhang J, Yan J, **Chillrud LG**, Benavides JP, Nunez Y, Herbstman JB, Goldsmith J, Wright J, Kioumourtzoglou M-A. Principal Component Pursuit for Pattern Identification in Environmental Mixtures. *Environmental Health Perspectives*, In Press 2022.

2. Rowland ST, **Chillrud LG**, Boehme AK, Wilson A, Rush J, Just AC, Kioumourtzoglou MA. Can Weather Help Explain 'Why Now?': The Potential Role of Hourly Temperature as a Stroke Trigger. *Environmental Research*. 2022 May 1;207:112229.

Workshop

1. Wang G, **Chillrud LG**, McKeown KR. Evidence based Automatic Fact-Checking for Climate Change Misinformation. *SocialSens Workshop on The International AAAI Conference on Web and Social Media*, 2021.

Presentations

Oral

10. **Chillrud LG**, Gibson EA, Nunez Y, Colgan R, Tao RH, Zhang J, Yan J, Wright J, Goldsmith J, Kioumourtzoglou M-A. Principal Component Pursuit for Pattern Recognition from Incomplete Environmental Data. *ENAR 2022*, Houston, TX, March 27-30, 2022.

9. Benavides JP, Nunez Y, **Chillrud LG**, Gibson EA, Kioumourtzoglou M-A. Pre- and Postnatal Urban Exposure Patterns and Childhood Neurobehavior. *Exposome Data Challenge*, ISGlobal, April 28-30, 2021.

Invited Talks

8. **Chillrud LG**. Parallel computation in R with the foreach package: A brief introduction. *RClub*, Columbia Mailman School of Public Health, New York, NY, April 7, 2022.

Posters

7. **Chillrud LG**, Yan J, Wright J, Goldsmith J, Kioumourtzoglou M-A. Principal Component Pursuit for Source Apportionment from Block Missing Data: An Application to NYC $PM_{2.5}$ Data. *ISEE 2022*, Athens, Greece, September 18-21, 2022.

6. **Chillrud LG**, Gibson EA, Nunez Y, Colgan R, Tao RH, Zhang J, Yan J, Wright J, Goldsmith J, Kioumourtzoglou M-A. Principal Component Pursuit for Exposure Pattern Recognition: An Application to Persistent Organic Pollutants and Leukocyte Telomere Length. *ISEE 2021*, New York, NY, August 23-26, 2021.

Presentations (ctd)

Abstracts

5. Benavides J, **Chillrud LG**, DeSerisy M, Cohen J, Goldsmith J, Kioumourtzoglou M-A, Margolis A. Do complex mixtures of prenatal environmental and social exposures explain variation in risk for behavioral symptoms in adolescence? *ISEE 2022*, Athens, Greece, September 18-21.

4. Wu H, Kalia V, Manz KE, **Chillrud LG**, Dishon NH, Orvieto R, Aizer A, Levine H, Kioumourtzoglou M-A, Pennell KD, Machtinger R, Baccarelli AA. Exposomic Analysis of Organic Pollutants in Seminal Plasma and Male Reproductive Parameters. *ISEE 2022*, Athens, Greece, September 18-21.

3. Rowland ST, **Chillrud LG**, Boehme AK, Wilson A, Rush J, Just AC, Kioumourtzoglou M-A. Can Weather Help Explain 'Why Now?': The Potential Role of Hourly Temperature as a Stroke Trigger. *ISEE 2021*, New York, NY, August 23-26.

2. Tao RH, Nunez Y, **Chillrud LG**, Rowland ST, Boehme AK, Kioumourtzoglou M-A. Source-specific Fine Particulate Matter and Hospitalization due to Myocardial Infarction. *ISEE 2021*, New York, NY, August 23-26.

1. Rowland ST, Makkar A, Benavides JP, **Chillrud LG**, Coull B, Fiore A, Henze D, Martin R, Milly GP, Donkelaar Av, Parks RM, Paisley J, Kioumourtzoglou M-A. Uncertainty characterization in $PM_{2.5}$ Predictions Across the Contiguous US. *ISEE 2021*, New York, NY, August 23-26.

Technical Skills

Languages:	Python, R, Java, LaTeX, C, C++, HTML, CSS, MATLAB, Bash, Zsh
Operating Sys:	UNIX, macOS
VC Systems:	Git, GitHub
Databases:	MongoDB, NoSQL
Certifications:	HIPAA, CITI, Human Subjects Protection
ML Libraries:	TensorFlow, Keras, PyTorch, Scikit-learn, Hugging Face Transformers, NumPy, SciPy, Pandas, Matplotlib, Seaborn
Dev Tools:	iTerm, Vim, tmux, RStudio, Jupyter Notebook, Google Cloud Platform, Homebrew, Conda

Relevant Coursework

Courses marked **in bold** indicate Graduate level coursework.

Computer Sci:	**Machine Learning for Medical Images & Signals**, **Machine Learning**, **Computational Genomics**, **Natural Language Processing**, **Artificial Intelligence**, **Analysis of Algorithms**, Computer Science Theory, Advanced Programming in C, Computer Systems, Data Structures & Algorithms
Mathematics:	**Mathematical (Linear) Optimization**, **Probability & Statistics**, Linear Algebra, Calculus I, II, & III, Discrete Mathematics, Number Theory, Cryptography
Other:	Geochemistry, Organic Chemistry I, General Chemistry I & II, General Chemistry Lab, Death Valley Geology, Intro Linguistics

Other Projects

11/2020 **Scraping Georgia Jails for Georgia Get Out the Vote**
Wrote a Python web-crawler to scrape Georgia's jails for information needed to help register incarcerated voters. Read more here.

10/2020 **RoBERTa for Claim Detection**
Fine-tuned RoBERTa under-the-hood to identify and rank claims worth fact-checking. Implemented with PyTorch and Scikit-learn. Read more here.

5/2020 **Automatic Diagnosis of COVID-19 Chest X-rays with Neural Nets**
Trained a CNN via transfer learning (TensorFlow) to diagnose patient chest x-rays from: COVID-19, no condition, viral-, or bacterial-pneumonia. Read more here.

5/2020 **SARS-CoV-2 Sequence Analysis**
Identified conserved RNA secondary structures across coronavirus spike proteins in a sequence analysis of SARS-CoV-2. Read more here.

References

References are available upon request. Academic transcripts are available upon request.