Hrayr Harutyunyan

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EDUCATION

University of Southern California **Aug. 2018 - May 2023**
PhD in Computer Science **Current GPA: 4.0**
Thesis: On information captured by neural networks:
connections with memorization and generalization [arXiv:2306.15918]
Advisors: Aram Galstyan and Greg Ver Steeg
Coursework:

- CSCI 670: Advanced analysis of algorithms, Fall 2018
- EE 546: Mathematics of high-dimensional data, Fall 2018
- DSO 699: Statistical learning theory, Spring 2018
- CSCI 699: Advanced topics in deep learning, Spring 2018
- CSCI 699: Theoretical machine learning, Fall 2019
- CSCI 699: Topics in Discrete Optimization and Learning, Fall 2020

Teaching assistantship:

- CSCI 670: Advanced analysis of algorithms, Fall 2019
- CSCI 270: Introduction to Algorithms and Theory of Computing, Spring 2020

Research assistantship:

- Global analysis of weak signals for enterprise event detection, Fall 2018 to Fall 2019
- Learning with less labels, Spring 2020 to Fall 2022

Yerevan State University **Sept. 2016 - June 2018**
MSc in Discrete Mathematics and Theoretical Informatics **GPA: 19.9/20**
Thesis: Extension of linear CorEx for time series
Advisor: Anahit Chubaryan

Yerevan State University **Sept. 2012 - June 2016**
BSc in Computer Science and Applied Mathematics **GPA: 19.6/20**
Thesis: Spoken language identification with deep learning
Advisor: Armen Andreasyan

EXPERIENCE

Google Research **July 2023 - Present**
Research Scientist *New York, NY, USA*

- Conducting research towards efficient and capable small langauge models (up to 10B parameters)
- Designing context length generalization (more than 30x) techniques of LLMs
- Contributing to Gemini Nano models
- Contributing to YouTube Search

Google Research **May 2022 - Aug. 2022, Sept. 2022 - Oct. 2022**
Research Intern, Student Researcher *New York, NY, USA*

Project: Supervision complexity and its role in knowledge distillation

- Introducing a new theoretical perspective on knowledge distillation through a measure of alignment between the teacher-provided supervision and the student's neural tangent kernel.

Amazon.com, Inc **May 2021 - Aug. 2021**
Applied Scientist Intern *Remote*

Project: Test error prediction and analysis via sample information measures

- Estimating the number of samples needed to reach a certain level of performance in a supervised learning task
- Finding which sub-populations of examples should be sampled more in order to achieve the goal efficiently

Amazon.com, Inc **May 2020 - Aug. 2020**
Applied Scientist Intern *Remote*

Project: Information content of samples

- Defining and estimating the unique information content of samples in supervised learning tasks

YerevaNN Research Lab **June 2016 - July 2018**
Machine Learning Researcher *Yerevan, Armenia*

- Establishing benchmarks for clinical prediction tasks
- Automated question answering using deep learning
- Representation learning with generative models

USC Information Sciences Institute **June 2017 - Sept. 2017**
Machine Learning Researcher, Intern *Marina Del Rey, CA, USA*

- Learning disentangled representations via synergy minimization
- Temporal covariance estimation using non-overlapping Gaussian latent factor models

RESEARCH INTERESTS

I focus on developing efficient and capable language models, particularly relatively smaller ones (up to 10 billion parameters). My research explores designing novel architectures and knowledge distillation techniques to improve both the quality and efficiency of these models. I also work on developing techniques to extend the context length of language models by over 30 times. More broadly, I am interested in novel self-supervised learning objectives, generalization phenomenon of deep neural networks, learning theory, in-context learning, and out-of-distribution generalization.

PUBLICATIONS AND PREPRINTS

[*] S. Bae, A. Fisch, **H. Harutyunyan**, Z. Ji, S. Kim, T. Schuster.
Relaxed Recursive Transformers: Effective Parameter Sharing with Layer-wise LoRA.
Under review, to appear on arXiv soon

[*] A. S. Rawat, V. Sadhanala, A. Rostamizadeh, A. Chakrabarti, W. Jitkrittum, V. Feinberg, S. Kim, **H. Harutyunyan**, N. Saunshi, Z. Nado, R. Shivanna, S. J. Reddi, A. K. Menon, R. Anil, S. Kumar.
A Little Help Goes a Long Way: Efficient LLM Training by Leveraging Small LMs.
Under review, to appear on arXiv soon

[1] A. Trockman, **H. Harutyunyan**, J. Z. Kolter, S. Kumar, S. Bhojanapalli.
Mimetic Initialization Helps State Space Models Learn to Recall.
arXiv:2410.11135, 2024

[2] **H. Harutyunyan**, R. Darbinyan, S. Karapetyan, H. Khachatrian.
In-context learning in presence of spurious correlations.
arXiv:2410.03140, 2024

[3] R. Darbinyan, **H. Harutyunyan**, A. Markosyan, H. Khachatrian.
Identifying and Disentangling Spurious Features in Pretrained Image Representations.
ICML SCIS Workshop, 2023

[4] A. Jain, G. Swaminathan, P. Favaro, H. Yang, A. Ravichandran, **H. Harutyunyan**, A. Achille, O. Dabeer, B. Schiele.
A Meta-Learning Approach to Predicting Performance and Data Requirements.
CVPR, 2023

[5] **H. Harutyunyan**, A.S. Rawat, A.K. Menon, S. Kim, S. Kumar.
Supervision Complexity and its Role in Knowledge Distillation.
ICLR, 2023

[6] **H. Harutyunyan**, GV. Steeg, A. Galstyan.
Formal limitations of sample-wise information-theoretic generalization bounds.
IEEE Information Theory Workshop, 2022

[7] T. Galstyan, **H. Harutyunyan**, H. Khachatrian, GV. Steeg, A. Galstyan.
Failure Modes of Domain Generalization Algorithms.
CVPR, 2022

[8] KSM. Hossain, **H. Harutyunyan**, Y. Ning, B. Kennedy, N. Ramakrishnan, A. Galstyan.
Identifying Geopolitical Event Precursors using Attention-based LSTMs.
Frontiers in Artificial Intelligence, 2022

[9] **H. Harutyunyan**, M. Raginsky, GV. Steeg, A. Galstyan.
Information-theoretic generalization bounds for black-box learning algorithms.
NeurIPS, 2021

[10] **H. Harutyunyan**, A. Achille, G. Paolini, O. Majumder, A. Ravichandran, R. Bhotika, S. Soatto.
Estimating informativeness of samples with Smooth Unique Information.
ICLR, 2021

[11] **H. Harutyunyan**, K. Reing, GV. Steeg, A. Galstyan.
Improving Generalization by Controlling Label-Noise Information in Neural Network Weights.
ICML, 2020

[12] GV. Steeg, **H. Harutyunyan**, D. Moyer, A. Galstyan.
Fast structure learning with modular regularization.
NeurIPS, 2019

[13] **H. Harutyunyan**, H. Khachatrian, DC. Kale, GV. Steeg, A. Galstyan.
Multitask learning and benchmarking with clinical time series data.
Nature Scientific Data, 2019.

[14] **H. Harutyunyan**, D. Moyer, H. Khachatrian, GV. Steeg, A. Galstyan
Efficient covariance estimation from temporal data.
arXiv:1905.13276, 2019

[15] S. Abu-El-Haija, B. Perozzi, A. Kapoor, N. Alipourfard, K. Lerman, **H. Harutyunyan**, GV. Steeg, A. Galstyan.
MixHop: higher-order graph convolutional architectures via sparsified neighborhood mixing.
ICML, 2019

[16] GV. Steeg, R. Brekelmans, **H. Harutyunyan**, A. Galstyan.
Disentangled representations via synergy minimization.
Allerton Conference on Communication, Control, and Computing (Allerton), 2017.

SKILLS

Programming Languages	Python, C/C++
Software & Tools	JAX, PyTorch, Tensorflow, Keras, MATLAB, Wolfram Mathematica
Languages	English, Armenian (native), Russian

AWARDS, HONORS AND ACHIEVEMENTS

KAUST Rising Stars in AI Symposium, Speaker 2023

USC Annenberg Graduate Fellow 2018

ACM ICPC World Finals, Finalist 2017

Google HashCode, Finalist 2017, 2018

Russian Code Cup, Finalist 2016

Yerevan State University Gold Medal 2016
For outstanding results in programming competitions

ACM ICPC Northeastern European Regional Contest
First Diploma, 17th place 2016
Second Diploma, 33th place 2015
Champion of Armenia 2013 - 2016
Champion of Southern Caucasus 2015, 2016

Open Southern Caucasus Championship, First Diploma 2013 - 2016

Independence Cup of Armenia, First Place 2013 - 2017

International Olympiad in Informatics, Bronze medal 2012

National Olympiads in Physics, Mathematics and Informatics
2 First, 2 Second, 3 Third Degree Diplomas 2008 - 2012

NOTABLE ACTIVITIES

FAST Foundation June 2021 - present
NextGen Council Member

Reviewing
NeurIPS'20 (outstanding reviewer), ICML'21, NeurIPS'21, ICLR'21, ICML'22, ICLR'23, ICML'23, NeurIPS'23, ICML'24, TMLR, NeurIPS'24

ACM ICPC Trainings at USC Fall 2018
Lecturer

Weekly Machine Learning Seminars Sept. 2017 - July 2018
Co-organizer
Presented and discussed recent advances in machine learning.

National Olympiad in Informatics 2013 - 2018
Committee member
Prepared tasks for the national Olympiad in informatics.
Trained students for international Olympiad in informatics.

International Olympiad in Informatics 2016
Deputy leader of Armenian national team
Trained students for the competition.

INTERESTS

Reading, art house, billiards, skiing, chess, music, philosophy.