

# Hrayr Harutyunyan

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## EDUCATION

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### 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

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### Google Research

July 2023 - Present

*Research Scientist*

*New York, NY, USA*

- Conducting research towards efficient and capable small language 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**

*Applied Scientist Intern*

**May 2021 - Aug. 2021**

*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**

*Applied Scientist Intern*

**May 2020 - Aug. 2020**

*Remote*

Project: Information content of samples

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

**YerevaNN Research Lab**

*Machine Learning Researcher*

**June 2016 - July 2018**

*Yerevan, Armenia*

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

**USC Information Sciences Institute**

*Machine Learning Researcher, Intern*

**June 2017 - Sept. 2017**

*Marina Del Rey, CA, USA*

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

## RESEARCH INTERESTS

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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-context generalization.

## PUBLICATIONS AND PREPRINTS

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- [\*] 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

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

## AWARDS, HONORS AND ACHIEVEMENTS

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**KAUST Rising Stars in AI Symposium, Speaker**

2023

<b>USC Annenberg Graduate Fellow</b>	2018
<b>ACM ICPC World Finals</b> , Finalist	2017
<b>Google HashCode</b> , Finalist	2017, 2018
<b>Russian Code Cup</b> , Finalist	2016
<b>Yerevan State University Gold Medal</b>	2016
For outstanding results in programming competitions	
<b>ACM ICPC Northeastern European Regional Contest</b>	
First Diploma, 17th place	2016
Second Diploma, 33th place	2015
Champion of Armenia	2013 - 2016
Champion of Southern Caucasus	2015, 2016
<b>Open Southern Caucasus Championship</b> , First Diploma	2013 - 2016
<b>Independence Cup of Armenia</b> , First Place	2013 - 2017
<b>International Olympiad in Informatics</b> , Bronze medal	2012
<b>National Olympiads in Physics, Mathematics and Informatics</b>	
2 First, 2 Second, 3 Third Degree Diplomas	2008 - 2012

## NOTABLE ACTIVITIES

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<b>FAST Foundation</b>	June 2021 - present
<i>NextGen Council Member</i>	
<b>Reviewing</b>	
NeurIPS'20 (outstanding reviewer), ICML'21, NeurIPS'21, ICLR'21, ICML'22, ICLR'23, ICML'23, NeurIPS'23, ICML'24, TMLR, NeurIPS'24	
<b>ACM ICPC Trainings at USC</b>	Fall 2018
<i>Lecturer</i>	
<b>Weekly Machine Learning Seminars</b>	Sept. 2017 - July 2018
<i>Co-organizer</i>	
Presented and discussed recent advances in machine learning.	
<b>National Olympiad in Informatics</b>	2013 - 2018
<i>Committee member</i>	
Prepared tasks for the national Olympiad in informatics.	
Trained students for international Olympiad in informatics.	
<b>International Olympiad in Informatics</b>	2016
<i>Deputy leader of Armenian national team</i>	
Trained students for the competition.	

## INTERESTS

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