

Haekyu Park

I'm a Ph.D. student in Computer Science at Georgia Tech, working with Dr. Polo Chau. My research goal is to address fundamental challenges in understanding **how machine learning models works** and **what they have learned**:

- How to scalably discover and summarize concepts that a model has learned?
- How to identify and explain vulnerabilities that the model is susceptible to?
- How do such concepts evolve as the model is trained?

Specifically, I create novel tools that enable interactive scalable discovery of concepts, evolutions, and vulnerabilities in deep learning. My research is supported by **JPMorgan AI PhD Fellowship**. I have been fortunate to work with amazing researchers, engineers, and scientists at Stripe, Microsoft, NVIDIA, and Intel.

✉ haekyu@gatech.edu 📄 CV 🎓 Google Scholar

Education

Georgia Institute of Technology

Ph.D., Computer Science

Advisor: Dr. **Polo Chau**

Aug 2018 - Present

Seoul National University

B.S., Computer Science and Engineering

Graduated with honors (Cum Laude)

Mar 2012 - Aug 2017

Honors and Awards

Rising Stars in EECS, 2022

Rising Stars in EECS, Hosted at the University of Texas at Austin

J.P.Morgan PhD Fellowship, 2021

J.P.Morgan PhD Fellowship for my PhD work "Human-centered AI: Interactive Scalable Interfaces for Trustworthy and Safe AI"

"Thank a Teacher" Award, 2019

Center of Teaching & Learning (CTL), Georgia Institute of Technology

Moon-Jung Chung Scholarship, 2019

KOCSEA (The Korean Computer Scientists and Engineers Association in America)

National Scholarship for Science and Engineering, 2019

National Scholarship for Science and Engineering

Experience

Stripe, Seattle, WA

- Machine Learning Engineering Intern
- Jun 2022 - Aug 2022
- Mentor: Revanth Rameshkumar
- Designed and implemented a deep neural network for **detecting fraud transctions**. The model's advanced design resulted in a remarkable **8x increase in training speed**, offering customers a significant boost in the

volume of fraud transactions detected. This is expected to result in a **yearly increase of \$4-5 million** in fraud detection, a substantial improvement over the previous model.

Microsoft Research, Redmond, WA

- Research Intern
- Jun 2021 - Aug 2021
- Mentor: Gonzalo Ramos
- Developed FoundWright, an interactive system to empowering people to **re-find information** that they have seen before online but that they might have forgotten how to get back to. With the support of an advanced language transformer model, FoundWright enables users to effectively express their search queries through **interactive collaboration between the users and the machine learning support**. Our research findings showcase the effectiveness of this innovative approach, as it significantly improves the re-finding process and offers a complementary solution to conventional search methods.

NVIDIA, Santa Clara, CA

- AI Infrastructure Software Intern
- May 2020 - Jul 2020
- Mentor: Joe Eaton, Brad Rees, Bartley Richardson
- We developed a visual graph analytics tool, designed for **interactive and real-time analysis of large graphs**. By leveraging the power of **GPU acceleration**, this tool enables users to easily run multiple graph algorithms, providing fast visualization of features of the graph. The combination of cutting-edge technology and intuitive visualizations make this tool useful for exploring and understanding complex graph data.

NVIDIA, Austin, TX

- Data Science Intern
- May 2018 - Aug 2019
- Mentor: Bartley Richardson, Brad Rees, Joe Eaton
- We showcased an approach to flagging anomalous network communications in a large graph using a combination of structural graph features and graph analytics, running end-to-end in RAPIDS. The internship result is presented at **KDD'19 NVIDIA RAPIDS tutorial**.

Grants and Funding

Cisco Research Funding (\$150k), 2022

- Co-authored proposal resulting in \$150k research funding from Cisco

WiML Travel Funding, 2019

- \$550 Travel Funding
- Women in Machine Learning Workshop, co-located with NeurIPS

Amazon AWS Research Grant, 2018

- Funded \$5,000 in AWS cloud credits
- Co-PIs: Nilaksh Das, Scott Freitas, Duen Horng Chau

Publications



Concept Evolution in Deep Learning Training: A Unified Interpretation Framework and Discoveries

Haekyu Park, Seongmin Lee, Benjamin Hoover, Austin P. Wright, Omar Shaikh, Rahul Duggal, Nilaksh Das, Kevin Li, Judy Hoffman, Duen Horng Chau



ACM International Conference on Information and Knowledge Management (CIKM), 2023

 Paper

Diffusion Explainer: Visual Explanation for Text-to-image Stable Diffusion

Seongmin Lee, Benjamin Hoover, Hendrik Strobelt, Zijie J. Wang, ShengYun Peng, Austin P. Wright, Kevin Li, [Haekyu Park](#), Haoyang Yang, Duen Horng Chau
IEEE Visualization Conference (VIS), 2023
 Paper  Demo



NeuroMapper: In-browser Visualizer for Neural Network Training

Zhiyan Zhou, Kevin Li, [Haekyu Park](#), Megan Dass, Austin P. Wright, Nilaksh Das, Duen Horng Chau
IEEE Visualization Conference (VIS), 2022
 Paper  Demo



Explaining Website Reliability by Visualizing Hyperlink Connectivity

Seongmin Lee, Sadia Afroz, [Haekyu Park](#), Zijie J. Wang, Omar Shaikh, Vibhor Sehgal, Ankit Peshin, Duen Horng Chau
IEEE Visualization Conference (VIS), 2022



DetectorDetective: Investigating the Effects of Adversarial Examples on Object Detectors

Sivapriya Vellaichamy, Matthew Hull, Zijie J. Wang, Nilaksh Das, Sheng-Yun Peng, [Haekyu Park](#), Duen Horng Chau
Conference on Computer Vision and Pattern Recognition (CVPR), Demo, 2022
 Demo  Paper


MisVis: Explaining Web Misinformation Connections via Visual Summary

Seongmin Lee, Sadia Afroz, [Haekyu Park](#), Zijie J. Wang, Omar Shaikh, Vibhor Sehgal, Ankit Peshin, Duen Horng Chau
CHI Conference on Human Factors in Computing Systems Extended Abstracts, 2022
 Demo  Paper



NeuroCartography: Scalable Automatic Visual Summarization of Concepts in Deep Neural Networks

[Haekyu Park](#), Nilaksh Das, Rahul Duggal, Austin P. Wright, Omar Shaikh, Fred Hohman, Duen Horng Chau
IEEE Visualization Conference (VIS), Virtual, 2021
 Demo  Paper

RECAST: Enabling User Recourse and Interpretability of Toxicity Detection Models with Interactive Visualization

Austin P. Wright, Omar Shaikh, [Haekyu Park](#), Will Epperson, Muhammed Ahmed, Stephane Pinel, Duen Horng Chau, Diyi Yang
24th ACM Conference on Computer-Supported Cooperative Work & Social Computing (CSCW), 2021.
 Paper

SkeletonVis: Interactive Visualization for Understanding Adversarial Attacks on Human Action Recognition Models



[Haekyu Park](#), Zijie J. Wang, Nilaksh Das, Anindya S. Paul, Pruthvi Perumalla, Zhiyan Zhou, Duen Horng Chau
AAAI, Demo, Virtual, 2021.
 Demo  Paper

Bluff: Interactively Deciphering Adversarial Attacks on Deep Neural Networks

Nilaksh Das*, [Haekyu Park](#)*, Zijie J. Wang, Fred Hohman, Robert Firstman, Emily Rogers, Duen Horng Chau
IEEE Visualization Conference, (VIS), Salt Lake City, UT, USA, 2020.
* Authors contributed equally.

 Demo  Paper

CNN Explainer: Learning Convolutional Neural Networks with Interactive Visualization

Zijie J. Wang, Robert Turko, Omar Shaikh, [Haekyu Park](#), Nilaksh Das, Fred Hohman, Minsuk Kahng, Duen Horng Chau
IEEE Conference on Visual Analytics Science and Technology, (VAST), Salt Lake City, UT, USA, 2020.
 Demo  Paper

A Comparative Analysis of Industry Human-AI Interaction Guidelines

Austin P. Wright, Zijie J. Wang, [Haekyu Park](#), Grace Guo, Fabian Sperrle, Mennatallah El-Assady, Alex Endert, Daniel Keim, Duen Horng Chau
IEEE Visualization Conference, Workshop on Trust and Expertise in Visual Analytics (TREX), Salt Lake City, UT, USA, 2020.

 Paper

Argo Lite: Open-Source Interactive Graph Exploration and Visualization in Browsers

Siwei Li, Zhiyan Zhou, Anish Upadhayay, Omar Shaikh, Scott Freitas, [Haekyu Park](#), Zijie J. Wang, Susanta Routray, Matthew Hull, Duen Horng Chau
ACM International Conference on Information and Knowledge Management, (CIKM), Resource Track, Online, 2020.

► Demo  Paper

Massif: Interactive Interpretation of Adversarial Attacks on Deep Learning

Nilaksh Das*, [Haekyu Park](#)*, Zijie J. Wang, Fred Hohman, Robert Firstman, Emily Rogers, Duen Horng Chau
ACM CHI Conference on Human Factors in Computing Systems (CHI), Late-Breaking Works, Honolulu, Hawaii, USA, 2020.

* Authors contributed equally.

 Paper

CNN 101: Interactive Visual Learning for Convolutional Neural Networks

Zijie J. Wang, Robert Turko, Omar Shaikh, [Haekyu Park](#), Nilaksh Das, Fred Hohman, Minsuk Kahng, Duen Horng Chau
ACM CHI Conference on Human Factors in Computing Systems (CHI), Late-Breaking Works, Honolulu, Hawaii, USA, 2020.

 Paper

Summit: Scaling Deep Learning Interpretability by Visualizing Activation and Attribution Summarizations

Fred Hohman, [Haekyu Park](#), Caleb Robinson, Duen Horng Chau
IEEE Transactions on Visualization and Computer Graphics (TVCG), Vancouver, BC, Canada, 2020.

► Demo  Paper

Visual Analytics for Interpretability on Deep Neural Networks

[Haekyu Park](#), Fred Hohman, Nilaksh Das, Caleb Robinson, Duen Horng Chau
Women in Machine Learning Workshop (WiML), co-located with NeurIPS 2019, Vancouver, BC, Canada, 2019.

MLsploit: A Framework for Interactive Experimentation with Adversarial Machine Learning Research

Nilaksh Das, Siwei Li, Chanil Jeon, Jinho Jung, Shang-Tse Chen, Carter Yagemann, Evan Downing, [Haekyu Park](#), Evan Yang, Li Chen, Michael Kounavis, Ravi Sahita, David Durham, Scott Buck, Duen Horng Chau, Taesoo Kim, Wenke Lee
ACM SIGKDD Conference on Knowledge Discovery and Data Mining (KDD), KDD Project, Anchorage, Alaska, USA, 2019.

► Demo  Paper

NeuralDivergence: Exploring and Understanding Neural Networks by Comparing Activation Distributions

[Haekyu Park](#), Fred Hohman, Duen Horng Chau
IEEE Pacific Visualization Symposium (PacificVis), Bangkok, Thailand, 2019.

► Demo  Paper

SIDE: Representation Learning in Signed Directed Networks

Junghwan Kim, [Haekyu Park](#), Ji-Eun Lee, U Kang
The Web Conference (Previously known as WWW, World Wide Web Conference), Lyon, France, 2018.

 Webpage  Paper

A Comparative Study of Matrix Factorization and Random Walk with Restart in Recommender Systems

[Haekyu Park](#), Jinhong Jung, U Kang
IEEE International Conference on Big Data (BigData), Boston, MA, USA, 2017.

 Webpage  Paper

Open-Source Projects

NeuroCartography: Scalable Automatic Visual Summarization of Concepts in Deep Neural Networks

- Keywords: Deep Learning Interpretability, Visualization, Human Interpretable Concepts Learned by a Model, Concept Cascade
- Interactive visual system that scalably summarizes and visualizes concepts learned by neural networks
- It was published at IEEE Visualization Conference (VIS), 2021.
- Haekyu Park, Nilaksh Das, Rahul Duggal, Austin P. Wright, Omar Shaikh, Fred Hohman, Duen Horng Chau
- ► Demo

SkeletonVis: Interactive Visualization for Understanding Adversarial Attacks on Human Action Recognition Models

- Keywords: Adversarial Attacks, Human Action Recognition
- Interactive visual system for understanding vulnerability of human action recognition model
- It was published at AAAI Demo, 2021.
- Haekyu Park, Zijie J. Wang, Nilaksh Das, Anindya S. Paul, Pruthvi Perumalla, Zhiyan Zhou, Duen Horng Chau
- ► Demo

CNN Explainer: Learning Convolutional Neural Networks with Interactive Visualization

- Keywords: Deep Learning Education, Interactive Visualization, Interactive Animation
- Interactive visual system for learning Convolutional Neural Networks
- It was published at IEEE VIS (VAST, TVCG), 2020.
- Zijie Jay Wang, Robert Turko, Omar Shaikh, Haekyu Park, Nilaksh Das, Fred Hohman, Minsuk Kahng, Duen Horng (Polo) Chau
- ► Demo 🏆 Top of Github Trending ★ 4,905 Github stars (as of Oct 2020)

Bluff: Interactively Deciphering Adversarial Attacks on Deep Neural Networks

- Keywords: Adversarial Attacks, Neural Network Interpretability, Activation Pathways, Interactive Visual Analytics
- Interactive system for visualizing, characterizing, and deciphering adversarial attacks on vision-based neural networks
- It was published at IEEE VIS, 2020.
- Nilaksh Das*, Haekyu Park*, Zijie Jay Wang, Fred Hohman, Robert Firstman, Emily Rogers, Duen Horng Chau (* Equal Contribution)
- ► Demo

Summit: Scaling Deep Learning Interpretability by Visualizing Activation and Attribution Summarizations

- Keywords: Neural Network Interpretability, Attribution Graph, Interactive Visual Analytics
- Interactive visualization that scalably summarizes what features a deep learning model has learned and how those features interact to make predictions
- It was published at IEEE VIS (VAST, TVCG), 2019.
- Fred Hohman, Haekyu Park, Caleb Robinson, Duen Horng Chau
- ► Demo


MLsploit: A Framework for Interactive Experimentation with Adversarial Machine Learning Research

- Keywords: Adversarial Attacks and Defenses for Machine Learning Models, Interactive Experimentation
- User-friendly, cloud-based system that enables researchers and practitioners to rapidly evaluate and compare state-of-the-art adversarial attacks and defenses for machine learning (ML) models
- It was published at a KDD 2019 Project Showcase.
- Fred Hohman, Haekyu Park, Caleb Robinson, Duen Horng Chau
- ► Demo

SIDE: Representation Learning in Signed Directed Networks



- Keywords: Network Embedding, Signed Weighted Directed Graph
- General network embedding method that represents both sign and direction of edges in the embedding space
- It was published at the Web Conference (WWW), 2018.
- 🌐 Webpage

A Comparative Study of Matrix Factorization and Random Walk with Restart in Recommender Systems

- Keywords: Recommender System, Matrix Factorization (MF), Random Walk with Restart (RWR)
- We provide a comparative study of MF and RWR, which are the most representative methods for recommender systems.
- It was published at IEEE Big Data, 2017.
-  Webpage

Other Projects

Accelerated Data Science Teaching Kit for Educators

- Keywords: GPU-accelerated Data Science, RAPIDS, NVIDIA Teaching Kits
- The first version of its GPU Accelerated Data Science Teaching Kit for educators
- Presented at NVIDIA's Graphics Technology Conference (GTC) 2021: Bridging Data Analytics and Machine Learning Skill Gaps with RAPIDS and the New Accelerated Data Science Teaching Kit for University Educators [S31763]
-  Data Science Teaching Kit  Blog

DARPA Guaranteeing AI Robustness against Deception (GARD)

- Keywords: Defenses for Adversarial Examples, Robustness, Defense using Semantic Coherence
- We develop defenses for adversarial attacks on object detector for both RGB images and single-camera video. We augment this object detector to support spatial, temporal, semantic coherence in videos.

RAPIDS and Cybersecurity: A Network Use Case

- Keywords: RAPIDS, NVIDIA, GPU-acceleration, Graph, Personalized Page Rank
- We showcased an approach to flagging anomalous network communications in a large graph using a combination of structural graph features and graph analytics, running end-to-end in RAPIDS.
- Presented at cybersecurity use case notebook.


Recommender System for Videos on Oksusu Application

- Keywords: Deep Learning, Sequence/Word Embedding, Approx. k-NN, Heterogeneous Features
- This system effectively recommends videos to users on the Oksusu application by efficiently managing and analyzing vast amounts of user behavior data and heterogeneous video information.
- SK Telecom, Seoul, Republic of Korea

A Fast Data Compression with Shared Virtual Memory in Heterogeneous System Architecture

- Keywords: OpenCL, GPGPU, SVM, HSA
- I employed the use of general-purpose computing on graphics processing units (GPGPU) and shared virtual memory (SVM) within a heterogeneous system architecture (HSA) to accelerate data deduplication methods. This approach offers a potent foundation for parallel computing, which can be programmed with ease and optimized for efficiency.
- Undergraduate thesis

Personalized Recommendation for Credit Card Rewards

- Keywords: Coupled Matrix Factorization, Time Series Data
- We provide personalized recommendations for credit card rewards to customers using various side information of users and items. The main algorithm is TCMF (Time Coupled Matrix Factorization).
- Hyundai Card, Seoul, Republic of Korea
-  News article (in Korean)

Talks

NeuroCartography: Scalable Automatic Visual Summarization of Concepts in Deep Neural Networks

- [Haekyu Park](#), Nilaksh Das, Rahul Duggal, Austin P. Wright, Omar Shaikh, Fred Hohman, Duen Horng Chau

- Oct 2021, IEEE Visualization Conference (VIS)

SkeletonVis: Interactive Visualization for Understanding Adversarial Attacks on Human Action Recognition Models

- [Haekyu Park](#), Zijie Jay Wang, Nilaksh Das, Anindya S. Paul, Pruthvi Perumalla, Zhiyan Zhou, Duen Horng Chau
- Feb 2021, Poster Presentation, AAAI

Bluff: Interactively Deciphering Adversarial Attacks on Deep Neural Networks

- Nilaksh Das*, [Haekyu Park](#)*, Zijie Jay Wang, Fred Hohman, Robert Firstman, Emily Rogers, Duen Horng Chau (* Equal Contribution)
- Oct 2020, Oral Presentation, IEEE VIS
- Oct 2020, Presentation, Michigan Institute for Data Science (MIDAS) Consortium for researchers in Training

Accelerated Data Science in the Classroom: Teaching Analytics and Machine Learning with RAPIDS

- Polo Chau and [Haekyu Park](#)
- Mar 2020, Talk, NVIDIA's GPU Technology Conference (GTC)

NeuralDivergence: Exploring and Understanding Neural Networks by Comparing Activation Distributions

- Apr 2019, Poster Presentation, PacificVis

A Comparative Study of Matrix Factorization and Random Walk with Restart in Recommender Systems

- Dec 2017, Oral Presentation, IEEE Big Data