

# Haekyu Park

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My research goal is to enhance **machine learning interpretability** to enable:

- **Confident use of machine learning**, by helping people interpret and trust the models
- **Effective model debugging and improvement**, by promoting practitioners' understanding of why a model would not work well and providing them insight into how to fix it
- **Broadening access to machine learning**, by encouraging people of diverse backgrounds to easily learn and leverage the technologies.

Specifically, I design and develop interactive visualization systems to interpret machine learning models. I am a member of the [Polo Club of Data Science](#) at Georgia Tech. I have been fortunate to work with amazing researchers, engineers, and scientists at NVIDIA and Intel.

## 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

## Research Experience

### AI Infrastructure Software Intern

NVIDIA, Santa Clara, CA

Mentor: Joe Eaton, Brad Rees, Bartley Richardson

Developed a visual graph analytics, allowing for interactively running multiple graph algorithms in real-time on large graphs.

Leveraged GPU acceleration for both data analysis and rendering side.

May 2020 - Jul 2020

### Data Science Intern

NVIDIA, Austin, TX

Mentor: Bartley Richardson, Brad Rees, Joe Eaton

Internship results are integrated into NVIDIA RAPIDS team's [cybersecurity usecase notebook](#), presented at [KDD 2019 NVIDIA RAPIDS tutorial](#).

May 2019 - Aug 2019

<b>Graduate Research Assistant</b>	Aug 2018 - Present
Georgia Institute of Technology, Atlanta, GA	
<b>Undergraduate Research Assistant</b>	June 2016 - Aug 2017
Seoul National University, Seoul, Republic of Korea	

## Awards & Honors

<b>"Thank a Teacher" Award</b>	2019
Center of Teaching & Learning (CTL), Georgia Institute of Technology	
<b>Moon-Jung Chung Scholarship</b>	2019
KOCSEA (The Korean Computer Scientists and Engineers Association in America)	
<b>National Scholarship for Science and Engineering</b>	2015
National Scholarship for Science and Engineering	

## Grants & Funding

<b>WiML Travel Funding</b>	2019
\$550 Travel Funding	
Women in Machine Learning Workshop, co-located with NeurIPS	
<b>Amazon AWS Research Grant</b>	2018
Funded \$5,000 in AWS cloud credits	
Co-PIs: Nilaksh Das, Scott Freitas, Duen Horng Chau	

## Publication

**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, and Duen Horng Chau  
AAAI, demo, Virtual, 2021.

**Bluff: Interactively Deciphering Adversarial Attacks on Deep Neural Networks**  
Nilaksh Das\*, Haekyu Park\*, Zijie Jay Wang, Fred Hohman, Robert Firstman, Emily Rogers, and Duen Horng Chau  
IEEE Visualization Conference, (VIS), Salt Lake City, UT, USA, 2020.  
\* Authors contributed equally.  
▶ Demo

**CNN Explainer: Learning Convolutional Neural Networks with Interactive Visualization**  
Zijie Jay 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

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

Siwei Li, Zhiyan Zhou, Anish Upadhyay, Omar Shaikh, Scott Freitas, [Haekyu Park](#), Zijie Jay Wang, Susanta Routray, Matthew Hull, and Duen Horng Chau

ACM International Conference on Information and Knowledge Management, ([CIKM](#)), Resource Track, Online, 2020.

► [Demo](#)

## **Massif: Interactive Interpretation of Adversarial Attacks on Deep Learning**

Nilaksh Das\*, [Haekyu Park](#)\*, Zijie Jay Wang, Fred Hohman, Robert Firstman, Emily Rogers, and Duen Horng Chau

ACM CHI Conference on Human Factors in Computing Systems (CHI), [Late-Breaking Works](#), Honolulu, Hawaii, USA, 2020.

\* Authors contributed equally.

PDF [arXiv](#)

## **CNN 101: Interactive Visual Learning for Convolutional Neural Networks**

Zijie Jay Wang, Robert Turko, Omar Shaikh, [Haekyu Park](#), Nilaksh Das, Fred Hohman, Minsuk Kahng, and Duen Horng Chau

ACM CHI Conference on Human Factors in Computing Systems (CHI), [Late-Breaking Works](#), Honolulu, Hawaii, USA, 2020.

PDF [arXiv](#)

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

Fred Hohman, [Haekyu Park](#), Caleb Robinson, and Duen Horng Chau

IEEE Transactions on Visualization and Computer Graphics ([TVCG](#)), Vancouver, BC, Canada, 2020.

► [Demo](#) PDF [arXiv](#)

## **Visual Analytics for Interpretability on Deep Neural Networks**

[Haekyu Park](#), Fred Hohman, Nilaksh Das, Caleb Robinson, and 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, and Wenke Lee

ACM SIGKDD Conference on Knowledge Discovery and Data Mining (KDD), [KDD Project](#), Anchorage, Alaska, USA, 2019.

► [Demo](#) PDF

## **MLsploit: A Cloud-Based Framework for 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, and Wenke Lee

Black Hat Asia - Arsenal, 2019.

► [Demo](#) Abstract [Video](#)

## **NeuralDivergence: Exploring and Understanding Neural Networks by Comparing Activation Distributions**

[Haekyu Park](#) Fred Hohman, and Duen Horng Chau

IEEE Pacific Visualization Symposium ([PacificVis](#)), Bangkok, Thailand, 2019.

► [Demo](#) PDF [arXiv](#)

## **SIDE: Representation Learning in Signed Directed Networks**

Junghwan Kim, [Haekyu Park](#), Ji-Eun Lee, and U Kang

The Web Conference (Previously known as [WWW](#), World Wide Web Conference), Lyon, France, 2018.

Project PDF [arXiv](#)

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

[Haekyu Park](#), Jinhong Jung, and U Kang

IEEE International Conference on Big Data ([BigData](#)), Boston, MA, USA, 2017.

Project PDF [arXiv](#)

# Open-Source Research Projects

## CNN Explainer: Learning Convolutional Neural Networks with Interactive Visualization

2020

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

2020

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

2019

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

2019

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.

► [Demo](#)

## SIDE: Representation Learning in Signed Directed Networks

2018

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.

► [Project](#)

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

2017

Keywords: Recommender System, Matrix Factorization, Random Walk with Restart

We provide a comparative study of matrix factorization and RWR, which are the most representative recommender systems.

It was published at IEEE Big Data, 2017.

► [Project](#)

# Other Projects

## DARPA Guaranteeing AI Robustness against Deception (GARD)

2019

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

2019

Keywords: RAPIDS, NVIDIA, GPU-acceleration, Graph, Personalized Page Rank

We showcase 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 [KDD 2019 NVIDIA RAPIDS tutorial](#) with the [cybersecurity use case notebook](#).

### Recommender System for Videos on Oksusu Application

2017

Keywords: Deep Learning, Sequence/Word Embedding, Approx. k-NN, Heterogeneous Features

Our system recommends videos to users of Oksusu application, handling massive data on users' behaviors and heterogeneous information of videos.

SK Telecom, Seoul, Republic of Korea

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

2017

Keywords: OpenCL, GPGPU, SVM, HSA

I used general purpose computing on graphics processing units (GPGPU) and Shared Virtual Memory (SVM) in Heterogeneous System Architecture (HSA) for fast data deduplication methods. GPGPU and HSA provide a powerful basis for parallel computing in an easy programmable and efficient way.

Undergraduate thesis

### Personalized Recommendation for Credit Card Rewards

2016

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 & Presentation

### 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

## Tutorial

### RAPIDS and Cybersecurity: A Network Use Case

Keywords: RAPIDS, NVIDIA, GPU-acceleration, Graph, Personalized Page Rank

Presented at [KDD 2019 NVIDIA RAPIDS tutorial](#) with the [cybersecurity use case notebook](#)

# Teaching

## Graduate Teaching Assistant

Georgia Institute of Technology, Atlanta, GA  
Data and Visual Analytics (CSE 6242)  
Instructor: Polo Chau

Fall 2019

# Mentoring

## Zhiyan Zhou

B.S. in Computer Science, Georgia Institute of Technology  
Visualization for Graph Exploration  
AI Robustness against Adversarial Attacks

Fall 2020 - Present

## Megan Dass

B.S. in Computer Science, Georgia Institute of Technology  
AI Robustness against Adversarial Attacks

Fall 2020 - Present

## Omar Shaikh

B.S. in Computer Science, Georgia Institute of Technology  
Visualization for natural language processing  
Received Outstanding Freshman Award

Fall 2019 - Present

## Rob Firstman

B.S. in Computer Science, Georgia Institute of Technology  
Visualization for deep learning interpretability

Fall 2019 - Spring 2020

## Robert Turko

B.S. in Computer Science, Georgia Institute of Technology  
Visualization for machine learning education

Fall 2019 - Spring 2020

# Licenses and Certifications

NVIDIA DLI Certificate – DLI Platform Course for Instructors, NVIDIA Deep Learning Institute  
NVIDIA DLI Certificate – Fundamentals of Deep Learning for Computer Vision, NVIDIA Deep Learning Institute

# Professional Service

## Reviewer

CIKM 2020  
VIS 2020  
WiML 2019  
KDD 2019  
ICML 2019

## **Professional Membership**

The Institute of Electrical and Electronics Engineers (IEEE). Since 2019.

# **Technical Skills**

### **Programming Languages**

Python, JavaScript, HTML, R, Matlab, Java, C, C++, Ocaml, Scheme

### **Machine Learning / Deep Learning / Data Science**

TensorFlow, PyTorch, Keras, scikit-learn, OpenCV, Numpy, Pandas, SciPy, NetworkX

### **GPU-accelerated Data Science**

cuGraph, cuDF, cuML, BlazingSQL, OpenCL

### **Data Visualization**

D3.js, Three.js, WebGL, HoloViews, Matplotlib, WebGL, ggplot