

# Fred Hohman

*Data science + visualization researcher*

I'm a Ph.D. student studying Computational Science and Engineering at Georgia Tech advised by Polo Chau and Alex Endert.

My research applies a human-centered approach to designing and developing interactive interfaces that help people understand and explain **machine learning models**. I also write, design, and build explorable explanations, dynamic expositions, and **interactive data visualizations** that illustrate complex ideas simply and tangibly.

In 2018 I received the NASA Space Technology Research Fellowship.



[fredhohman.com](http://fredhohman.com)



[@fredhohman](https://twitter.com/fredhohman)



[github.com/fredhohman](https://github.com/fredhohman)



Google Scholar



CV PDF

Updated: December 14, 2018

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## Education

Present —

### **Ph.D. in Computational Science & Engineering**

Aug. 2015

Georgia Institute of Technology, Atlanta, GA

Advisor: Duen Horng (Polo) Chau, Co-advisor: Alex Endert

Overall GPA: 4.00/4.00

May 2018

### **M.S. in Computational Science & Engineering**

Georgia Institute of Technology, Atlanta, GA

May 2015 —

### **B.S. in Mathematics, B.S. in Physics**

Aug. 2011

University of Georgia, Athens, GA

Thesis: "3D Printing the Trefoil Knot and its Pages"

Overall GPA: 3.84/4.00, Magna Cum Laude, Area of Emphasis in Applied Mathematics

## Industry Research Experience

Summer 2018

**Microsoft Research**, Redmond, WA

*Research Intern, Human-Computer Interaction Group*

Mentor: Steven Drucker

Exploring how visual analytics can help users explain and interpret machine learning models.

Summer 2017

**NASA Jet Propulsion Lab**, Pasadena, CA

*Creative Computer Scientist, Human Interfaces Group*

Mentor: Scott Davidoff, Arun Viswanathan

Joint work between NASA JPL, Caltech, and Art Center creating interactive data visualizations for current scientific research.

Summer 2016

**Pacific Northwest National Lab**, Richland, WA

*National Security Ph.D. Intern, Data Sciences & Analytics Group*

**Mentor: Nathan Hodas**

Built interactive visualization tools that generate images from deep neural networks to explain classifier's learned semantics.

## Academic Research Experience

Present —

**Georgia Institute of Technology**, Atlanta, GA

Aug. 2016

*Graduate Research Assistant, School of Computational Science and Engineering*

Advisor: Duen Horng (Polo) Chau, Alex Endert

Member of the Polo Club of Data Science where we bridge and innovate at the intersection of data mining and human-computer interaction to synthesize scalable, interactive, and interpretable tools that amplify human's ability to understand and interact with big data.

May 2016 —

**Georgia Institute of Technology**, Atlanta, GA

Aug. 2015

*Graduate Research Assistant, School of Computational Science and Engineering*

Mentor: Surya Kalidindi

Conducted research in physical data science and material informatics by creating property-structure linkages using machine learning to predict material properties. Contributed to direction and code of PyMKS: Materials Knowledge Systems in Python.

May 2015 —

**University of Georgia**, Athens, GA

Jan. 2013

*Undergraduate Research Assistant, Department of Mathematics*

Advisor: David Gay

Explored 3D printing and mathematical exposition in topology. Programmed, designed, and 3D printed 34-piece, color-coordinated, and magnetized 3D puzzle of the trefoil knot fibration. Led 3D printing research and education in mathematics department.

Summer 2014

**REU in Mathematics and Computational Science**, Fairfield, CT

*Fairfield University, Department of Mathematics*

Mentor: Shanon Reckinger

Directly compared numerical solutions derived from the Navier-Stokes equations to designed experiments performed at the lab-scale to model specific ocean phoneme. Configured MIT General Circulation Model on a linux computer cluster to run parallel computational fluid dynamics simulations.

## Honors and Awards

2018

**Best Paper, Honorable Mention at VISxAI Workshop at IEEE VIS**

For "The Beginner's Guide to Dimensionality Reduction"

2018 — 2021

**NASA Space Technology Research Fellowship**

For my Ph.D. work on "Understanding Deep Neural Networks Through Attribution and Interactive Experimentation"

2018

**Audience Appreciation Award, Runner Up at ACM SIGKDD Conference**

For "Shield: Fast, Practical Defense and Vaccination for Deep Learning using JPEG Compression"

2017 — 2018

**Microsoft Azure for Research Award: AI for Earth**

For our work on "Deep Learning for Fine-scale Population Maps"

2017

**Best Demo, Honorable Mention at ACM SIGMOD/PODS Conference**

For "Visual Graph Query Construction and Refinement"

2015 — 2019

**President's Fellowship at Georgia Institute of Technology**

Select number of 1st year doctoral students who bring exemplary levels of scholarship and innovation to their academic departments

2015

**Outstanding Poster at JMM Undergraduate Poster Session in Computational Math**

For "Experimental and Numerical Comparison of Oceanic Overflow"

2015

**UGA CURO Research Graduation Distinction**

Awarded to undergraduates who write a thesis, present at the CURO Symposium, and complete 9 research credit hours

2014

**UGA CURO Research Assistantship**

Stipend awarded to outstanding undergraduates that actively participate in faculty-mentored research

2013

**Presidential Scholar**

Achieved a 4.0 GPA during a semester with minimum 14 credit hours

2011 — 2015

**Dean's List**

Achieved at least a 3.5 GPA during a semester with minimum 14 credit hours

- 2011 — 2015 **Georgia HOPE Scholarship**  
Merit-based award to Georgia residents providing tuition assistance for their undergraduate degree
- 2011 **Mission of Blessed Trinity: Artistic Sensibility**  
One of two students to receive the Mission Statement award upon high-school graduation
- 2009 **Eagle Scout Award**  
Highest achievement attainable in the Boy Scouts of America, only 4% of scouts granted this rank

## Publications

### Scalable K-Core Decomposition for Static Graphs Using a Dynamic Graph Data Structure

Alok Tripathy, Fred Hohman, Duen Horng (Polo) Chau, Oded Green

*IEEE International Conference on Big Data (Big Data). Seattle, WA, USA, 2018.*

[Project](#) [PDF](#)

### Visual Analytics in Deep Learning: An Interrogative Survey for the Next Frontiers

Fred Hohman, Minsuk Kahng, Robert Pienta, Duen Horng (Polo) Chau

*IEEE Transactions on Visualization and Computer Graphics (TVCG). Berlin, Germany, 2018.*

[Project](#) [PDF](#) [Video](#) [Code](#)

### The Beginner's Guide to Dimensionality Reduction

Matthew Conlen, Fred Hohman

*Workshop on Visualization for AI Explainability at IEEE VIS (VISxAI). Berlin, Germany, 2018.*

[Project](#) [Code](#) [Best Paper, Honorable Mention](#)

### Compression to the Rescue: Defending from Adversarial Attacks Across Modalities

Nilaksh Das, Madhuri Shanbhogue, Shang-Tse Chen, Fred Hohman, Siwei Li, Li Chen, Michael E. Kounavis, Duen Horng (Polo) Chau

*ACM KDD 2018 Project Showcase. London, UK, 2018.*

[Project](#) [PDF](#) [Code](#)

### Shield: Fast, Practical Defense and Vaccination for Deep Learning using JPEG Compression

Nilaksh Das, Madhuri Shanbhogue, Shang-Tse Chen, Fred Hohman, Siwei Li, Li Chen, Michael E. Kounavis, Duen Horng (Polo) Chau

*ACM SIGKDD Conference on Knowledge Discovery and Data Mining (KDD). London, UK, 2018.*

[Project](#) [PDF](#) [Video](#) [Code](#) [Audience Appreciation Award, Runner Up](#)

### Large Graph Exploration via Subgraph Discovery and Decomposition

James Abello, Fred Hohman, Varun Bezzam, Duen Horng (Polo) Chau

*arXiv:1808.04414. 2018.*

[Project](#) [PDF](#)

### Interactive Classification for Deep Learning Interpretation

Angel Cabrera, Fred Hohman, Jason Lin, Duen Horng (Polo) Chau

*Demo, Conference on Computer Vision and Pattern Recognition (CVPR). Salt Lake City, UT, USA, 2018.*

[Project](#) [PDF](#) [Video](#) [Code](#)

### A Deep Learning Approach for Population Estimation from Satellite Imagery

Caleb Robinson, Fred Hohman, Bistra Dilkina

*1st ACM SIGSPATIAL Workshop on Geospatial Humanities. Redondo Beach, CA, USA, 2017.*

[Project](#) [PDF](#) [Code](#) [Microsoft AI for Earth Award](#)

### VIGOR: Interactive Visual Exploration of Graph Query Results

Robert Pienta, Fred Hohman, Alex Endert, Acar Tamersoy, Kevin Roundy, Chris Gates, Shamkant Navathe, Duen Horng (Polo) Chau

*IEEE Transactions on Visualization and Computer Graphics (Proc. VAST). Phoenix, AZ, USA, 2018.*

[Project](#) [PDF](#) [Video](#) [Preview](#)

### 3D Exploration of Graph Layers via Vertex Cloning

James Abello, Fred Hohman, Duen Horng (Polo) Chau

IEEE Conference on Visual Analytics Science and Technology (VAST). Phoenix, AZ, USA, 2017.

[Project](#) [PDF](#) [Video](#) [Poster](#)

### A Viz of Ice and Fire: Exploring Entertainment Video Using Color and Dialogue

Fred Hohman, Sandeep Soni, Ian Stewart, John Stasko

2nd Workshop on Visualization for the Digital Humanities at IEEE VIS (VIS4DH). Phoenix, AZ, USA, 2017.

[Project](#) [PDF](#) [Code](#) [Data](#)

### mHealth Visual Discovery Dashboard

Dezhi Fang, Fred Hohman, Peter Polack, Hillol Sarker, Minsuk Kahng, Moushumi Sharmin, Mustafa al'Absi, Duen Horng (Polo) Chau

Demo, ACM International Joint Conference on Pervasive and Ubiquitous Computing (Ubicomp). Maui, HI, USA, 2017.

[Project](#) [PDF](#) [Video](#) [Poster](#)

### Keeping the Bad Guys Out: Protecting and Vaccinating Deep Learning with JPEG Compression

Nilaksh Das, Madhuri Shanbhogue, Shang-Tse Chen, Fred Hohman, Li Chen, Michael E. Kounavis, Duen Horng (Polo) Chau

arXiv:1705.02900. 2017.

[Project](#) [PDF](#) [Code](#)

### Visual Graph Query Construction and Refinement

Robert Pienta, Fred Hohman, Acar Tamersoy, Alex Endert, Shamkant Navathe, Hanghang Tong, Duen Horng (Polo) Chau

Demo, ACM International Conference on Management of Data (SIGMOD/PODS). Chicago, IL, USA, 2017.

[Project](#) [PDF](#) [Video](#) [Poster](#) [Best Demo, Honorable Mention](#)

### ShapeShop: Towards Understanding Deep Learning Representations via Interactive Experimentation

Fred Hohman, Nathan Hodas, Duen Horng (Polo) Chau

Extended Abstracts on ACM Human Factors in Computing Systems (CHI). Denver, CO, USA, 2017.

[Project](#) [PDF](#) [Video](#) [Poster](#) [Code](#)

### Experimental and Numerical Comparison of Oceanic Overflow

Thomas Gibson, Fred Hohman, Theresa Morrison, Shanon Reckinger, Scott Reckinger

Abstract, American Physical Society Division of Fluid Dynamics (APS DFD). San Francisco, CA, USA, 2014.

[Project](#) [Poster](#)

## Talks

### Visual Analytics in Deep Learning: An Interrogative Survey for the Next Frontiers

Oct. 2018 University of Georgia

Oct. 2018 IEEE Visualization

### The Beginner's Guide to Dimensionality Reduction

Oct. 2018 VISxAI Workshop at IEEE Visualization

### Comparing Interactive Local and Global Explanation Paradigms for Human-assisted Machine Learning Tasks

July 2018 Microsoft Research

### Graph Playgrounds: 3D Exploration of Graph Layers via Vertex Cloning

Dec. 2017 AT&T Research Labs Graduate Student Symposium

### A Viz of Ice and Fire: Exploring Entertainment Video Using Color and Dialogue

Oct. 2017 2nd Workshop on Visualization for the Digital Humanities at IEEE Visualization

### Constellation: Visualizing Cybersecurity in Real Time

Aug. 2017 NASA Jet Propulsion Lab (JPL)

Aug. 2017 California Institute of Technology

### Visualizing Learned Semantics with Deep Learning

Nov. 2016 Georgia Tech Ph.D. Qualifying Oral Exam

- 2016 **Drawing Semantics with Deep Learning**  
Pacific Northwest National Laboratory
- Mar. 2015 **3D Printing The Trefoil Knot And Its Pages**  
UGA Center for Undergraduate Research Symposium, included hands-on demo
- June 2015 **Experimental and Numerical Studies of Oceanic Overflow**  
AMS Conference on Atmospheric and Oceanic Fluid Dynamics
- Jan. 2015 Joint Mathematics Meeting
- Nov. 2014 APS Division of Fluid Dynamics
- Aug. 2014 Invited and presented on behalf at Brown University, Los Alamos National Lab
- July 2014 Northeast REU Mini-Conference at Yale University
- July 2014 University of Rhode Island Bay Campus
- Mar. 2014 **3D Printing in Topology**  
UGA Center for Undergraduate Research Symposium, included hands-on demo

## Press

- June 2018 "Georgia Tech Teams up with Intel to Protect Artificial Intelligence from Malicious Attacks Using SHIELD", Georgia Tech, College of Computing
- Apr. 2018 "CSE Ph.D. Students Claim Three Prestigious Fellowships", Georgia Tech, College of Computing
- Dec. 2017 "Georgia Tech Team To Use Microsoft Grant to Study Human Migration Dynamics", Georgia Tech, College of Computing
- Sept. 2015 "Georgia Tech PhD Student Puts Finishing Touches on 3D Printed Trumpety Trefoil", 3dprint.com
- Spring 2015 "Student Profile: Fred Hohman", 2015 UGA Mathematics Department Newsletter
- Feb. 2015 "Falling Water", MITgcm.org
- Dec. 2014 "Mathematics/Physics Student Creates 3D Printed Puzzle of Trefoil Knot, Catches Mathematical Community's Interest", 3dprint.com
- July 2014 "Day 311 - Trefoil Trumpet", Makerhome.com
- Apr. 2014 "Mathematics with 3D Printing", Sketches of Topology

## Teaching

- Spring 2017 **Graduate Teaching Assistant**  
*Georgia Institute of Technology, Atlanta, GA*  
Data and Visual Analytics (CSE6242 / CX4242), Instructor: Duen Horng (Polo) Chau  
Designed homeworks, held weekly office hours, and mentored student team projects for Data and Visual Analytics (CSE6242 / CX4242), a graduate course with 225+ students enrolled.
- 2014 — 2015 **Student Notetaker**  
*University of Georgia, Athens, GA*  
Generated notes for undergraduate mathematics and physics courses for students with disabilities.
- 2012 **Tutor**  
*University of Georgia, Athens, GA*  
Specialized in tutoring calculus to undergraduates.

## Mentoring

- Present — **Angel Cabrera**  
Spring 2018 *B.S. in Computer Science, Georgia Institute of Technology*  
Visualization for machine learning fairness, interactive classification for deep learning  
Now: Software Engineering Intern at Google

- Spring 2018 — **Dezhi Fang**  
Fall 2016 *B.S. in Computer Science, Georgia Institute of Technology*  
Visual motif discovery  
Now: Software Development Engineer at Airbnb
- Spring 2018 — **Prasenjeet Biswal**  
Fall 2017 *M.S. in Computer Science, Georgia Institute of Technology*  
Deep learning attribution  
Now: Software Development Engineer at Oath

## Grants and Funding

- 2018 — 2021 **Understanding Deep Neural Networks Through Attribution and Interactive Experimentation**  
NSTRF: NASA Space Technology Research Fellowship  
Co-PIs: Duen Horng (Polo) Chau  
Funded \$75,000/year
- 2017 — 2018 **Deep Learning for Fine-scale Population Maps**  
Microsoft Azure for Research Award: AI for Earth  
Co-PIs: Caleb Robinson, Bistra Dilkina  
Funded \$15,000
- Fall 2014 **3D Printing the Trefoil Knot and its Pages**  
UGA CURO Research Assistantship  
Co-PIs: David Gay  
Funded \$1,000

## Explorable Explanations

- Dec. 2018 — **The Parametric Press**  
An experimental, born-digital magazine dedicated to showcasing the expository power that's possible when the audio, visual, and interactive capabilities of dynamic media are effectively combined
- Nov. 2018 **Blueberry Pancakes**  
Caleb Robinson, Fred Hohman  
A toy algorithms problem
- July 2018 **The Beginner's Guide to Dimensionality Reduction**  
Matthew Conlen, Fred Hohman  
Explore the methods that data scientists use to visualize high-dimensional data, ★ **VISxAI Best Paper, Honorable Mention**
- June 2018 **The Math of Card Shuffling**  
Fred Hohman  
Riffling from factory order to complete randomness, ★ **Top of Hacker News**
- Oct. 2017 **A Viz of Ice and Fire**  
Fred Hohman, Sandeep Soni, Ian Stewart, John Stasko  
Exploring and visualizing Game of Thrones using color and dialogue

## Design

- 2017 — 2018 **IDEA Workshop Proceedings Cover (2017, 2018)**  
*ACM SIGKDD Workshop on Interactive Data Exploration and Analytics (IDEA)*  
Designed workshop poster and conference proceedings cover
- 2017 **Brad Myers Advisee Tree**  
*ACM Conference on Human Factors in Computing Systems (CHI), Denver, USA*  
Designed and implemented an interactive visualization of Brad Myers's advisee tree shown during his CHI 2017 Lifetime Research Award talk; designed accompanying ribbon worn by attendees at the conference

Aug. 2014

### **3D Printed Cube Decomposition Trophy**

*University of Georgia Mathematics Department, Athens, USA*

Designed, modeled, and 3D printed cube decomposition trophy for annual UGA High School Math Tournament that was given to the top scoring teams and participants

Aug. 2014

### **3D Printed UGA Keychain**

*University of Georgia Lamar Dodd School of Art, Athens, USA"*

Created 3D printed UGA keychain and presentation notes given at Experience UGA: a interdisciplinary event that exposes middle-school and high-school students to hands-on learning activities

## Technology Skills

**OS:** Mac OS X, Ubuntu, Unix Command Line, Windows

**Programming:** Python, Matlab, Mathematica, C

**Web:** HTML, CSS, JavaScript, D3, SQL, Bootstrap, LaTeX, Markdown, Jekyll, Git

**Graphics:** Affinity Designer, Pixelmator, Matplotlib, Blender, Keynote, Meshlab, MakerBot Desktop

**HCI:** Contextual Inquiry, Think-Alouds, User Personas, Rapid Paper Prototyping, Affinity Diagraming

## Service

### **Program Committee**

ACM International Conference on Intelligent User Interfaces (**IUI**) 2019

Symposium on Visualization in Data Science (**VDS**) at IEEE VIS 2018

Workshop on Visualization for AI Explainability (**VISxAI**) at IEEE VIS 2018

Workshop on Interactive Data Exploration and Analytics (**IDEA**) at KDD 2018

### **Reviewer**

ACM Conference on Human Factors in Computing Systems (**CHI**) 2019, 2018, 2017

IEEE Visual Analytics Science and Technology (**VAST**) 2017, 2018

1st Deep Learning and Security Workshop (**DLS**) at IEEE SP 2018

Symposium on Visualization in Data Science (**VDS**) at IEEE VIS 2017

ACM SIGKDD Conference on Knowledge Discovery and Data Mining (**KDD**) 2017

IEEE International Conference on Distributed Computing Systems (**ICDCS**) 2017

SIAM International Conference on Data Mining (**SDM**) 2017

### **Member**

2016 — Association for Computing Machinery (**ACM**)

2016 — Institute of Electrical and Electronics Engineers (**IEEE**)

2012 — 2015 UGA Mathematics Club

2012 — 2013 Society of Physics Students, UGA Chapter (**SPS**)

2011 — 2015 National Society of Collegiate Scholars (**NSCS**)

## References

**Dr. Polo Chau**, Associate Professor

School of Computational Science and Engineering

Georgia Institute of Technology

Atlanta, GA, USA

[cc.gatech.edu/~dchau/](http://cc.gatech.edu/~dchau/)

**Dr. Alex Endert**, Assistant Professor

School of Interactive Computing

Georgia Institute of Technology

Atlanta, GA, USA  
[va.gatech.edu/endert](http://va.gatech.edu/endert)

**Dr. Scott Davidoff**, Manager  
Human Interfaces Group  
NASA Jet Propulsion Lab  
Pasadena, CA, USA  
[scottdavidoff.com](http://scottdavidoff.com)

**Dr. Steven Drucker**, Principal Researcher  
Visualization and Interactive Data Analysis Group  
Microsoft Research  
Redmond, WA, USA  
[microsoft.com/en-us/research/people/sdrucker](http://microsoft.com/en-us/research/people/sdrucker)

**Dr. Nathan Hodas**, Senior Research Scientist  
Data Sciences and Analytics Group  
Pacific Northwest National Laboratory  
Richland, WA, USA  
[signatures.pnnl.gov/bios/nathan-hodas](http://signatures.pnnl.gov/bios/nathan-hodas)

## Contact

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