

# 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.

I have worked at Microsoft Research, NASA Jet Propulsion Laboratory, and Pacific Northwest National Laboratory.

In 2018 I received the NASA Space Technology Research Fellowship.

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 CV PDF

 @fredhohman  
 github.com/fredhohman  
 Google Scholar

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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 phenomena. 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

## Publications

### **Gamut: A Design Probe to Understand How Data Scientists Understand Machine Learning Models**

Fred Hohman, Andrew Head, Rich Caruana, Robert DeLine, Steven Drucker

*ACM Conference on Human Factors in Computing Systems (CHI). Glasgow, UK, 2019.*

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

### **Managing Messes in Computational Notebooks**

Andrew Head, Fred Hohman, Titus Barik, Steven Drucker, Robert DeLine

*ACM Conference on Human Factors in Computing Systems (CHI). Glasgow, UK, 2019.*

→ Coming soon! [BibTeX](#)

### **Atlas: Local Graph Exploration in a Global Context**

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

*ACM Conference on Intelligent User Interfaces (IUI). Los Angeles, CA, USA, 2019.*

[Project](#) [PDF](#) [Video](#) [Code](#) [BibTeX](#) \* Authors contributed equally

### **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](#) [BibTeX](#)

### **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](#) [Blog](#) [Video](#) [Code](#) [BibTeX](#)

### **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](#) [BibTeX](#) 🏆 **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

*Project Showcase, ACM SIGKDD Conference on Knowledge Discovery and Data Mining. London, UK, 2018.*

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

### **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](#) [BibTeX](#) 🏆 **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](#) [BibTeX](#) \* Authors contributed equally

### **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](#) [BibTeX](#)

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

Caleb Robinson, Fred Hohman, Bistra Dilkina

1st ACM SIGSPATIAL Workshop on Geospatial Humanities (GeoHum.). Redondo Beach, CA, USA, 2017.

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

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

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

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

[Project](#) [PDF](#) [Video](#) [Poster](#) [BibTeX](#) \* Authors contributed equally

### 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](#) [BibTeX](#)

### 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](#) [BibTeX](#)

### 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](#) [BibTeX](#)

### 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](#) [BibTeX](#) [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](#) [BibTeX](#)

### 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

### Explaining Machine Learning Models Using Interactive Visualization

Mar. 2019 Symantec Research Labs

Mar. 2019 NASA Jet Propulsion Laboratory

### Atlas: Local Graph Exploration in a Global Context

Mar. 2019 ACM Intelligent User Interfaces

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

Jan. 2019 Carnegie Mellon University

Oct. 2018 University of Georgia

Oct. 2018 IEEE Visualization

Oct. 2018	<b>The Beginner's Guide to Dimensionality Reduction</b> VISxAI Workshop at IEEE Visualization
July 2018	<b>Comparing Interactive Local and Global Explanation Paradigms for Human-assisted Machine Learning Tasks</b> Microsoft Research
Dec. 2017	<b>Graph Playgrounds: 3D Exploration of Graph Layers via Vertex Cloning</b> AT&T Research Labs Graduate Student Symposium
Oct. 2017	<b>A Viz of Ice and Fire: Exploring Entertainment Video Using Color and Dialogue</b> 2nd Workshop on Visualization for the Digital Humanities at IEEE Visualization
Aug. 2017	<b>Constellation: Visualizing Cybersecurity in Real Time</b> NASA Jet Propulsion Laboratory
Aug. 2017	California Institute of Technology
Nov. 2016	<b>Visualizing Learned Semantics with Deep Learning</b> Georgia Tech Ph.D. Qualifying Oral Exam
2016	<b>Drawing Semantics with Deep Learning</b> Pacific Northwest National Laboratory
Mar. 2015	<b>3D Printing The Trefoil Knot And Its Pages</b> UGA Center for Undergraduate Research Symposium, included hands-on demo
June 2015	<b>Experimental and Numerical Studies of Oceanic Overflow</b> 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	<b>3D Printing in Topology</b> UGA Center for Undergraduate Research Symposium, included hands-on demo

## Press

Dec. 2018	"Human Rights' May Help Shape Artificial Intelligence in 2019", Georgia Tech, College of Computing
Dec. 2018	"Designers, Programmers, and Researchers Join Forces to Create a New Kind of Digital Magazine Called the Parametric Press", Georgia Tech, College of Computing
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 2019 **Graduate Teaching Assistant**  
*Georgia Institute of Technology, Atlanta, GA*  
Information Visualization (CS 4460), Instructor: Alex Endert  
Designed homeworks, held weekly office hours, and mentored student team projects for Information Visualization (CS 4460), an undergraduate course with 134 students enrolled.
- Spring 2017 **Graduate Teaching Assistant**  
*Georgia Institute of Technology, Atlanta, GA*  
Data and Visual Analytics (CSE 6242 / CX 4242), Instructor: Duen Horng (Polo) Chau  
Designed homeworks, held weekly office hours, and mentored student team projects for Data and Visual Analytics (CSE 6242 / CX 4242), a graduate course with 214 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

- Present — **The Parametric Press**  
Matthew Conlen, Fred Hohman, Sara Stalla, Victoria Uren

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  
Riffing 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 and Writing:** 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

Debugging Machine Learning Models Workshop (**DebugML**) at ICLR 2019

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  
Human-Centered Machine Learning Perspectives Workshop (**HCMLP**) 2019  
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**) 2019, 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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