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
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github.com/fredhohman
Google Scholar

Education

Present — Aug. 2015 **Ph.D. in Computational Science & Engineering**
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 — Aug. 2011 **B.S. in Mathematics, B.S. in Physics**
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 — Aug. 2016 **Georgia Institute of Technology**, Atlanta, GA
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 — Aug. 2015 **Georgia Institute of Technology**, Atlanta, GA
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 — Jan. 2013 **University of Georgia**, Athens, GA
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

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

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

The Beginner's Guide to Dimensionality Reduction
Oct. 2018 VISxAI Workshop at IEEE Visulization

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

Drawing Semantics with Deep Learning

2016 Pacific Northwest National Laboratory

3D Printing The Trefoil Knot And Its Pages

Mar. 2015 UGA Center for Undergraduate Research Symposium, included hands-on demo

Experimental and Numerical Studies of Oceanic Overflow

June 2015 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

3D Printing in Topology

Mar. 2014 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 — Spring 2018 **Angel Cabrera**
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 — Fall 2016 **Dezhi Fang**
B.S. in Computer Science, Georgia Institute of Technology
Visual motif discovery
Now: Software Development Engineer at Airbnb

Spring 2018 — Fall 2017 **Prasenjeet Biswal**
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
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 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 Commitee

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**) 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/

Dr. Alex Endert, Assistant Professor
School of Interactive Computing
Georgia Institute of Technology
Atlanta, GA, USA
va.gatech.edu/endert

Dr. Scott Davidoff, Manager
Human Interfaces Group
NASA Jet Propulsion Lab
Pasadena, CA, USA
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

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

Contact

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