Fred Hohman

Data science + visualization researcher

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My research combines **data mining and machine learning** techniques with principles from **human-computer interaction and visualization** to make interactive tools to help people explore large graph data and interpret machine learning models. In 2018 I received the NASA Space Technology Research Fellowship.

Education

Present — Aug. 2015 **Ph.D. Computational Science and Engineering**
Georgia Institute of Technology, Atlanta, GA
Advisor: Polo Chau, Co-advisor: Alex Endert
Minor: "User-Centered Design in Data Science"
Overall GPA: 4.00/4.00

May 2018 **M.S. Computational Science and Engineering**
Georgia Institute of Technology, Atlanta, GA

May 2015 — Aug. 2011 **B.S. Mathematics**, Area of Emphasis in Applied Mathematics
B.S. Physics
University of Georgia, Athens, GA
Thesis: "3D Printing the Trefoil Knot and its Pages"
Overall GPA: 3.84/4.00, Magna Cum Laude

Industry Research Experience

Summer 2018 **Microsoft Research**, Redmond, WA
Research Intern, Human-Computer Interaction Group
Mentor: Steven Drucker
Exploring how visual analytics can help explain and interpret deep 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 Science and Analytics Group
Mentor: Nathan Hodas
Built 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: Polo Chau, Co-advisor: 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

Advisor: 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

Mentor: 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 **NSF REU in Mathematics and Computational Science**, Fairfield, CT
Undergraduate Researcher, Fairfield University, Department of Engineering

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

2018-2021 NASA Space Technology Research Fellowship
For my Ph.D. work on "Understanding Deep Neural Networks Through Attribution and Interactive Experimentation"

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
Selected incoming Ph.D. students who bring exemplary 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 upon graduation)
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

Interactive Classification for Deep Learning Interpretation. Angel Cabrera, Fred Hohman, Jason Lin, Duen Horng Chau. *Demo, Conference on Computer Vision and Pattern Recognition (CVPR). June 18, 2018. Salt Lake City, USA.*

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 Chau. *arXiv:1802.06816*. Feb 19, 2017.

Visual Analytics in Deep Learning: An Interrogative Survey for the Next Frontiers. Fred Hohman, Minsuk Kahng, Robert Pienta, Duen Horng Chau. *arXiv:1801.06889*. Jan 21, 2017.

A Deep Learning Approach for Population Estimation from Satellite Imagery. Caleb Robinson, Fred Hohman, Bistra Dilkina. *ACM SIGSPATIAL Workshop on Geospatial Humanities*. Nov 7, 2017. *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 Chau.
IEEE Transactions on Visualization and Computer Graphics (Proc. VAST'17). Jan 2018. Phoenix, USA.

3D Exploration of Graph Layers via Vertex Cloning. James Abello*, Fred Hohman*,
Duen Horng Chau. *Poster, IEEE Visual Analytics Science and Technology (VAST). Oct 1-6, 2017. Phoenix, USA.*

A Viz of Ice and Fire: Exploring Entertainment Video Using Color and Dialogue. Fred Hohman, Sandeep Soni, Ian Stewart, John Stasko. 2^{nd} *Workshop on Visualization for the Digital Humanities at IEEE VIS. Oct 1-6, 2017. Phoenix, USA.*

mHealth Visual Discovery Dashboard. Dezhi Fang, Fred Hohman, Peter Polack, Hillol Sarker, Minsuk Kahng, Moushumi Sharmin, Mustafa al'Absi, Duen Horng Chau. *Demo, ACM International Joint Conference on Pervasive and Ubiquitous Computing (UBICOMP)*. Sept 11-15, 2017. Maui, USA.

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 Chau. *arXiv:1705.02900*. May 8, 2017.

Visual Graph Query Construction and Refinement. Robert Pienta, Fred Hohman, Acar Tamersoy, Alex Endert, Shamkant Navathe, Hanghang Tong, Duen Horn Chau. *Demo, ACM International Conference on Management of Data (SIGMOD/PODS) Conference*. May 14-19, 2017. Chicago, USA. *Best Demo, Honorable Mention*.

ShapeShop: Towards Understanding Deep Learning Representations via Interactive Experimentation. Fred Hohman, Nathan Hodas, Duen Horng Chau. *Late-Breaking Work, ACM Conference on Human Factors in Computing Systems (CHI)*. May 6-11, 2017. Denver, CO, USA.

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*. Nov 23-25, 2014. San Francisco, CA, USA.

Presentations

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 VIS.

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

July 2016 Pacific Northwest National Laboratory. National Security Internship Program Research Symposium.

3D Printing The Trefoil Knot And Its Pages

Mar. 2015 UGA Center for Undergraduate Research Symposium. Hands on demo.

Experimental and Numerical Studies of Oceanic Overflow

June 2015 American Meteorological Society's 20th Conference on Atmospheric and Oceanic Fluid Dynamics.

Jan. 2015 Joint Mathematics Meeting. Outstanding Poster at Student Poster Session in Computational Math.

Nov. 2014 American Physical Society 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. Hands on demo.

Press

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.

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.

April 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: Polo Chau
Designed homeworks, held weekly office hours, and mentored student team projects for Data and Visual Analytics (CSE6242 / CX4242) a graduate course with 220+ 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.

Grants and Funding

2017 **Understanding Deep Neural Networks Through Attribution and Interactive Experimentation**
NSTRF: NASA Space Technology Research Fellowship
Co-PIs: Duen Horng Chau
Funded $75,000/year, August 2018 - May 2021.

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, August 2017 - August 2018.

Design

2017 **IDEA Workshop Proceedings Cover**
ACM SIGKDD Workshop on Interactive Data Exploration and Analytics (IDEA), Halifax, Canada
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.

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.

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

Professional Activities

Reviewer
1st Deep Learning and Security Workshop (**DLS**) at IEEE SP 2018
Symposium on Visualization in Data Science (**VDS**) at IEEE VIS 2017
IEEE Visual Analytics Science and Technology (**VAST**) 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
ACM Conference on Human Factors in Computing Systems (**CHI**) 2017, 2018

Member
Present-2016 Association for Computing Machinery (**ACM**)
Present-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, Assistant Professor
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Dr. Alex Endert, Assistant Professor
School of Interactive Computing
Georgia Institute of Technology
Atlanta, GA, USA
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Dr. Scott Davidoff, Manager
Human Interfaces Group
NASA Jet Propulsion Lab
Pasadena, CA, USA
scottdavidoff.com/

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

Dr. David Gay, Associate Professor
Department of Mathematics
University of Georgia
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