Kathryn Heal

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ABOUT

My doctoral studies focused on computational representations of the general solution set of an inherently ill-posed problem in computer vision, with a secondary emphasis on approximation of operators via artificial neural network meta-learning. I received my Ph.D. from Harvard in May of 2021.
I am currently on the job market for positions in Los Angeles (or remote West Coast) that combine vision-related research and product.

EDUCATION

Harvard University
Ph.D. in Applied Mathematics, May 2021. Advisor: Todd Zickler.
S.M. in Applied Mathematics, November 2016.

UCLA
B.S. in Applied Mathematics, June 2014.

EMPLOYMENT

X, the Moonshot Factory (formerly Google[x]):
AI Resident, 2020 - 2021.
Developed a novel computer vision deep learning pipeline to solve a very ill-posed inverse design problem in manufacturing, where the cost function is expensive to evaluate. Patent submitted.

Harvard University:
C.S. Draper Laboratory Fellow, 2014-2020.
Graduate Research Assistant, 2014 - 2021.
Designed and trained a novel neural architecture for local shape from shading. Developed a theoretical framework and proved general statements about minimal problems in local low-level 3D reconstruction.

Max Planck Institute for Mathematics in the Natural Sciences:
Visiting Scholar, 2019.
Formulated a problem in computational algebra as a weighted-graph traversal task, and trained a deep neural network ensemble to extrapolate missing edge weights of the graph.

AWARDS

- C.S. Draper Laboratory competitive doctoral fellowship, 2014 - 2020.
- Harvard University Certificate of Distinction in Teaching based on student evaluations, 2016.

LANGUAGES

Experienced: Python, TensorFlow, MATLAB, Mathematica, Magma.
Intermediate: C++, Java, Git, Bash CLI, HPC cluster instruction, Blender, Illustrator/Photoshop.

GRADUATE COURSEWORK

Randomized Algorithms, Computational Geometry, Data Science, Estimation & Control Theory, Functional Analysis, Applied Algebra, Algebraic Topology, Differential Topology, Biomedical Signal/Image Processing.

TEACHING Teaching fellow for Introduction to Probability (ES150), Spring 2016.

SELECTED PUBLICATIONS

1. Heal K, Kulkarni A, Sertöz EC. Deep learning gauss-manin connections. arXiv preprint https://arxiv.org/abs/2007.13786, 2020.
2. Heal K, Wang J, Gortler SJ, Zickler T. A Lighting-Invariant Point Processor for Shading. *CVPR* (Oral), 2020.
3. Deng Z, Ding J, Heal K, Tarokh V. *The Number of Independent Sets In Hexagonal Graphs.* 2017 IEEE International Symposium on Information Theory, 2017.
4. Magnusson S, Heal K, Enyioha C, Li N, Fischione C, Tarokh V. *Convergence of Limited Communications Gradient Methods.* American Control Conference, 2016.
5. Gilles J, Heal K. *A Parameterless Scale-Space Approach To Find Meaningful Modes In Histograms – Application To Image and Spectrum Segmentation.*

SELECTED INVITED TALKS

- Upcoming
  - Talk on Gauss-Manin work, SIAM Conference on Mathematics of Data Science, San Diego Sept 2022.
  - Applied Algebra Seminar, University of Wisconsin at Madison, March 2022.
- *Representing the Space of Visual Depth Ambiguities as a Real Affine Variety.*
  - Talk. SIAM Conference on Applied Algebraic Geometry, August 2021
  - Talk. Carnegie Mellon University Graphics, February 2021
  - Talk. CVPR, June 2020.
  - Talk. Graphics Colloquium, MIT Fall 2019.
  - Poster. Ideals, Varieties, and Algorithms, Amherst College June 2019.
  - Talk. Max Planck Institute, Leipzig April 2019.
  - Talk. Algebraic Vision research cluster, ICERM February 2019.
  - Poster. Workshop on Real Algebraic Geometry, ICERM October 2018.
- *The Number of Independent Sets in Hexagonal Graphs.* Talk. International Symposium on Information Theory 2017.
- *Induced Probability Measures on Persistence Diagrams.* Poster. SIAM Algebraic Geometry 2017.
- *Estimating the Reach of a Manifold.* Talk. Learning, Intelligence, and Signal Processing seminar, Boston University 2016.

RESEARCH EXPERIENCE

- 2016 - 2021, Harvard SEAS // Shape from shading; representing the space of visual depth ambiguities as a real affine variety.
- 2014 - 2016, Harvard SEAS // Designing and analyzing distributed algorithms for optimal energy management, i.e. strategies for smart grid. Demand response strategies where the system is only allowed very limited communication.
- 2013 - 2014, UCLA Department of Mathematics // Developing novel methods to visualize neural patterns within EEG data; custom wavelet development and corresponding signal decompositions.
- Summer 2012, Research in Industrial Projects for Students (RIPS IPAM) // Developing novel reconstruction methods for Digital Elevation Modeling.

REFERENCES *References available upon request.*