

Hae Jin (Hayley) Song

PHD CANDIDATE · COMPUTER SCIENCE

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Education

Ph.D. Candidate in Computer Science

UNIVERSITY OF SOUTHERN CALIFORNIA

- Advisor: Prof. Laurent Itti

Los Angeles, CA

2018 Fall - present

Master of Science in Electrical Engineering and Computer Science

MASSACHUSETTS INSTITUTE OF TECHNOLOGY (MIT)

- Advisor: Prof. Regina Barzilay, Dr. Julian Straub
- Concentration: Artificial Intelligence

Cambridge, MA

2016 - 2018

Bachelor of Science in Electrical Engineering and Computer Science

MASSACHUSETTS INSTITUTE OF TECHNOLOGY (MIT)

- Minor in Mathematics

Cambridge, MA

2012 - 2016

Professional Experience

2021-present	USC Information Science Institute (Visual Information & Multimedia Analysis Lab) , Graduate Research Assistant
2020 Summer	MathWorks , Research Internship
2018-2021	USC Knowledge Computing Lab , Graduate Research Assistant
2018	Apple Inc. , Co-op for 6 months
2016-2018	MIT CSAIL (advisor: Prof. Regina Barzilay, Dr. Julian Straub) , Graduate Research Assistant (Masters thesis)
2015-2016	MIT LIDS (advisor: Dr. Suvrit Sra) , SuperUROP Researcher
2014 Summer	MIT CSAIL (Anyscale Learning For All) , Undergraduate Research Assistant
2012	MIT Mcgovern Institute for Brain Research (Graybiel Lab) , Undergraduate Research Assistant
2012 Spring	MIT Media Lab (Camera Culture Group) , Undergraduate Research Assistant

Publications

– Conferences and journals with peer-reviews

- H.Song**, M.Khayatkhoei, W.AbdAlmageed. **ManiFPT: Defining and Analyzing Fingerprints of Generative Models**. *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*. 2024. <https://arxiv.org/abs/2402.10401>
- H.Song**, M.Khayatkhoei, W.AbdAlmageed. **Formal Definition of Fingerprints Improves Attribution of Generative Models**. *NeurIPS Workshop on Attributing Model Behavior at Scale*. 2023.
- Y.Gil et al. **Artificial intelligence for modeling complex systems: taming the complexity of expert models to improve decision making**. *ACM Transactions on Interactive Intelligent Systems*. 2021
- B.Modad, X.Yu, **H.Song**, Y.Chiang, A.Molisch. **Cell-by-Cell Line-of-Sight Probability Models Based on Real-World Base Station Deployment**. *IEEE Global Communications Conference (GLOBECOM)*. 2022
- M.Rodriguez, X.Zhao, **H.Song**,... & H.Fathy. **A Gradient-Based Approach for Coordinating Smart Vehicles and Traffic Lights at Intersections**. *IEEE Control Systems Letters*. 2020

– Preprints

- H.Song**, P.Krawczuk, P.H.Huang. **Application of Disentanglement to Map Registration Problem**. *arXiv preprint*. 2024. <https://arxiv.org/abs/2408.14152>

H.Song, W.AbdAlmageed. Learning Robust Representations of Generative Models Using Set-Based Artificial Fingerprints. *arXiv preprint*. 2022. <https://arxiv.org/abs/2206.02067>

– Master’s Thesis

H.Song. Non-rigid registration of mammogram images using Large Displacement Optical Flow with extended flexibility for manual interventions *Masters Thesis, MIT*. 2018. <https://dspace.mit.edu/handle/1721.1/119572>

Presentations

– INVITED TALKS

Invited talk at LG AI Tech CONNECT, 2024 (Title: *Fingerprinting Generative Models for Responsible A.I.*) **Spotlight**

Invited talk at Unstructured Studio, online. 2019. (Title: *Making Hybrid Images using Python*)

– PRESENTATIONS & TUTORIALS

H.Song, 2024. ManiFPT: Defining and Analyzing Fingerprints of Generative Models. **USC CS Bytes Seminar**

H.Song, M.Khayatkhoei, W.AbdAlmageed. 2023. Formal Definition of Fingerprints Improves Attribution of Generative Models. **NeurIPS Workshop on Attributing Model Behavior at Scale**

H.Song, 2021. Scientific application of machine learning. Talk presentation. **SciPy Conference**

H.Song, 2019. Experimental ML with HoloViews, Geoview, & PyTorch. Tutorial session (1.5 hr). **PyData LA (Link)**

Awards & Scholarships

- 2024 **Travel Award for CVPR 2024**, Women in Science and Engineering, University of Southern California
- 2024 **Travel Award for LG AI TechCONNECT Conference (Invited Spotlight Talk)**, LG AI Research
- 2023 **Travel Award for NeurIPS 2023**, USC Information Science Institute
- 2016 **MIT EECS Foxconn Undergraduate Research and Innovation Scholar**, Research and Innovation Scholars Program

Research Experience

USC Information Science Institute – Visual Information and Multimedia Analysis Lab

Los Angeles, CA

GRADUATE RESEARCH ASSISTANT

2021 - present

- Developed a learning-based algorithm to extract unique and traceable “fingerprints” of generative models from a large array of models including VAEs, GANs, Flows and diffusion models, and improved the accuracy of model attribution; studied the structure of the space of generative models using their learned fingerprint representations and clustering analysis
- Presented findings at academic conferences and seminars

SFI Complex Systems Summer School

Santa Fe/Remote

SELECTED INVITEE TO COMPLEX SYSTEMS SUMMER SCHOOL AT SANTA FE INSTITUTE

2021 Summer

- Project: Information flow in a multiplayer Urban-Ecology landscape
- Collaborated with a multi-disciplinary team of researchers across various institutes
- Worked towards writing a grant proposal to organize a long program

USC Knowledge Computing Lab

Los Angeles, CA

GRADUATE RESEARCH ASSISTANT (ADVISOR: PROF. YAO-YI CHIANG, PROF. CRAIG KNOBLOCK)

2018 - 2021

- Developed machine learning algorithms for disentangling the semantics and styles of geographic map images (e.g., satellite images, Google Street Maps and historical maps) using structured VAE and adversarial learning
- Studied learning-based methods for representing latent semantics of geographic information from satellite and map images to align and fuse spatial imageries from different sources (LiDAR, Cartography archives, satellite images)
- Developed and deployed an interactive system for visualizing large-scale geographic and spatiotemporal data to support an economic decision-making workflow (“MINT-GeoViz”)

MIT Computer Science & Artificial Intelligence Laboratory

Cambridge, MA

GRADUATE RESEARCH ASSISTANT (ADVISOR: PROF. REGINA BARZILAY)

2017 - 2018

- Masters Thesis: Non-rigid registration of mammogram images using large displacement optical flow with extended flexibility for manual interventions. [Thesis Link](#)
- Studied deformable image alignment using Optical Flow and Demons algorithm to localize and track tumors
- Improved learning algorithms for estimating the displacement field on medical images for user-specified alignments

MIT Computer Science & Artificial Intelligence Laboratory

Cambridge, MA

GRADUATE RESEARCH ASSISTANT (ADVISOR: PROF. REGINA BARZILAY, DR. JULIAN STRAUB)

2016 - 2017

- Topic: Computer Vision and 3D reconstruction for medical analysis (early diagnosis of lymphedema on breast cancer patients)
- Developed a multi-camera system for 3D reconstruction of human arms for early diagnosis of lymphedema using multiple depth sensors (Intel Realsense)
- Developed algorithms for 3D point cloud alignment and detection of minute volume changes from 3D point clouds, using functional maps
- Studied visual magnification of small volume changes, detected from the 3D point clouds

MIT Laboratory for Information and Decision Systems

Cambridge, MA

UNDERGRADUATE RESEARCH (SUPERUROP) (ADVISOR: DR. SUVRIT SRA)

2015 - 2016

- Topic: Building a robust, interactive reading device for a printed text using Optical Character Recognition
- Developed a software for a hand-held, pen-style device that recognizes user-selected texts on printed media (e.g., books, magazines) and performs a real-time dictionary lookup of the words
- Deployed a proof-of-concept application that employs Optical Character Recognition, filtering and image processing for real-time word extraction and recognition on mobile devices

INRIA – ILDA lab

Saclay, France

SUMMER RESEARCH INTERN (ADVISOR: DR. EMMANUEL PIETRIGA, DR. CAROLINE APPERT)

Summer, 2015

- Developed and optimized an automated system for recognizing gestures on wall-sized displays for tangible, gestural user interaction with visual information
- Implemented a recommendation system that identifies the most useful set of gestures for interacting with the wall-sized displays
- Developed a web application for Human Computer Interaction researchers that supports uploading of their datasets and recommends optimal parameters for their gesture recognition system

MIT CSAIL – Anyscale Learning For All

Cambridge, MA

UNDERGRADUATE RESEARCH (UROP) (ADVISOR: DR. KALYAN VEERAMACHANENI)

Summer, 2014

- Designed predictive models for large data from medical and physical sciences using data reduction, regression, and Gaussian Models on the cloud servers
- Parsed and organized raw data using Python and MATLAB; conducted statistical data analysis for feature selection

MIT Mcgovern Institute for Brain Research – Graybiel Lab

Cambridge, MA

UNDERGRADUATE RESEARCH (UROP). (ADVISOR: DR. LEIF GIBB)

2012

- Studied the neural mechanism of rats' decision-making process by predicting their reaction times from 1D and 2D neural data
- Developed an algorithm for estimating, from 2D images, the 3D distances between an injection site on a rat brain and other major regions of the brain
- Automated the process of image alignment and outlier detection on the brain scans of rats using ImageJ and MATLAB
- Organized a large amount of neural data into a database, and improved the efficiency of data retrieval using MATLAB

MIT Media Lab – Camera Culture Group

Cambridge, MA

UNDERGRADUATE RESEARCH (UROP)

Spring, 2012

- Designed and developed glass-free 3D image layers and prototypes for an exhibition using a laser cutter
- Reduced by half the amount of materials required for a glass display by optimizing their layouts

Internship Experience

Automated Negotiation System for Transportation

Remote

MATHWORKS

Jun. - Aug., 2020

- Developed a generative model based on VAE and RNN to learn representations of different driving behaviors from real traffic data and to simulate new traffic scenarios with user control
- Implemented a system for simulating and visualizing different traffic scenarios by sampling from the driving-behavior models learned from real-world data
- Analyzed traffic patterns, such as the rate of accidents and congestion, using a combination of real and simulated data
- Published a paper to a IEEE journal

Anomaly Detection for iPhone Defects using Machine Learning

Sunnyvale, CA

APPLE INC.

Feb. - Aug., 2018

- Developed a machine-learning based algorithm to detect and predict abnormal behaviors in iPhones using convolutional neural networks and decision trees
- Designed experiments for testing the acoustic functionality of iPhones, and implemented a system for automating the data collection and acoustic signal processing

Computer Vision for Robot Localization and Object Detection

Paris, France

KEECKER ROBOTICS

May - Aug., 2016

- Developed a computer-vision system for a robust detection of landmark signs by a robot in the real-world setting, under the variation of illumination and scale
- Improved the localization accuracy of a moving robot via more accurate camera calibration with Aruco and OpenCV in C++

Other Projects

- Generating Gaussian, Pictures, and Stories with Generative Adversarial Networks. [Technical Report](#)
- MINT-GeoViz: Interactive visualization tool for spatiotemporal data and deep neural network models. [Demo Link](#)
- Automatic Cell Detection using HOG features and SVM. [Technical Report](#), [Slides](#)
- Unintrusive Reading Device for a Printed Text (MIT EECS SuperUROP Poster Sessions, 2016). [Technical Report](#)
- 3D air gesture recognition using Dynamic Time Warping and KNN (MIT EECS Poster Sessions, 2016). [Code](#), [Slides](#)
- IOS application for 3D gesture recognition on air using Dynamic Time Warping and KNN
- Optimization of the blog traffic using a distributed memory caching system (Memcached)
- Analysis of Tweets and essays using Twitter API, sentiment analyzer and statistical inference techniques
- Modeling of Hidden Markov Model of a robot using message-passing algorithms
- Implementation of sampling techniques (Metropolis-Hasting, Gibbs) and Monte Carlo simulations

Teaching Experience

Fall 2024 **Machine Learning for Data Science (USC, DSCI 552) – Graduate level**, Teaching Assistant

Summer
2024 **Machine Learning for Data Science (USC, DSCI 552) – Graduate level**, Teaching Assistant

Summer 2021 **Foundations of Machine Learning (USC, CSCI 567) – Graduate level**, Teaching Assistant

Spring 2020 **Introduction to Artificial Intelligence (USC, CSCI 360)**, Teaching Assistant

Fall 2017 **Advanced Natural Language Processing (MIT, 6.864) – Graduate level**, Teaching Assistant

Spring 2016 **Engineering Computation and Data Science (MIT, 1.001)**, Teaching Assistant

Service & Professional Development

OPENSOURCE CODE

ReprLearn. ReprLearn is a codebase that facilitates the training of generative models using PyTorch and PyTorch-Lightning. <https://github.com/cocoaaa/ReprLearn>

TaileMani. TaileMani is a codebase for creating a large-scale dataset of map tile images from heterogeneous sources, such as satellite image servers and popular map rendering engines, including Google Street Maps, CartoDB and Stamen API. It also supports computing various spatial features from geospatial images or their graph representations (e.g., average number of intersections, road bearings, between centrality, or density-based metrics like FSI, GSI) and facilitates the training of a model for representing urban spaces. <https://github.com/cocoaaa/TileMani>

SERVICE AND OUTREACH

2012-2013 MIT Yearbook and Photography Club (*Technique*), Publicity Editor
2012-2013 MIT Experimental Study Group, Associate Advisor
2012-2013 MIT Korean Class, Volunteer Teacher

PROFESSIONAL DEVELOPMENT

Complex Systems Summer School at Santa Fe Institute (SFI): Selected to attend a 3 week-long summer school organized by SFI in 2021. My research project focused on modeling information flow in urban ecosystems

Geo4Good Summit at Google: Selected to attend a 3-day summit at Google. I learned various computational tools for analyzing geospatial data using traditional and machine-learning based methods

PEER REVIEW

NeurIPS, ICML, ACM Multimedia, SIGSPATIAL, ICTAI

SKILLS

Languages: Korean (Native), English (Fluent), French (Intermediate)

Programming: C++, Python, PyTorch, MATLAB, Android Programming, Web Development