Sahil Garg

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Research Interest

For the past 10 years, I have been conducting *problem-driven* research, exploiting problem structure for a given domain, to develop novel solutions for real-world tasks, and been making significant contributions to the field of *artificial intelligence*, published for top-tier conferences in *computer science*.

Machine Learning (low resource, robustness, interpretative, explainable, nearly unsupervised, information theory, non-parametric, sparse modeling, feature selection, nonstationary kernels for explicit attention, convolution kernels, recurrent neural networks, randomized algorithms, Bayesian models).

Natural Language Processing (discourse analysis, biomedical relation extraction, text clustering/classification, document analysis, text search, semantic parsing).

Deep Neural Networks (continual learning, optimization, representation learning).

Network Science (generative models, phase transition, link prediction).

Neuroscience (auto-encoding, neurogenesis, life-long continual learning).

Robotics (planning for information gathering, spatio-temporal dynamics, reinforcement learning, non-stationary phenomena).

Computational Psychiatry (early diagnosis, therapeutic dialogues, psychosis, schizophrenia, post-traumatic stress disorder, chronic pain, major depression, drug addiction, anti-NMDA receptor encephalitis, drug abuse, suicidal ideation, Alzheimer's).

Education

University of Southern California (USC) Aug 2013 -Aug 2019
PhD in Computer Science (Machine Learning) Advisor: Aram Galstyan
Title: "Hashcode Representations of Natural Language for Relation Extraction"
Committee: Aram Galstyan (chair), Kevin Knight, Irina Rish, Greg Ver Steeg, Roger Ghanem (external).

Thapar Institute of Engineering and Technology July 2005 - July 2009
Bachelor of Engineering (B.E.) in Computer Science

Present Employment

Morgan Stanley July 2020 - till date
Vice President, Machine Learning Research Manager: Yuriy Nevmyvaka
As a member of the center of excellence at Morgan Stanley, I am responsible for working with business and IT teams across the firm to solve mission-critical problems, developing advanced AI models for revenue generating business cases.

Employment History

08/19 - 07/20 Postdoc, Icahn School of Medicine at Mount Sinai

05/13 - 08/19 Graduate Research Assistant, University of Southern California

01/11 - 05/13	Research Assistant, IIIT Delhi
06/10 - 11/11	Software Engineer & Co-founder, Snowpal Software Services
08/09 - 06/11	Software Engineer & Founding Member, Commdel

Selected Publications

Conference Proceedings

Modeling Dialogues with Hashcode Representations. Sahil Garg*, Irina Rish, Guillermo Cecchi, Palash Goyal, Sarik Ghazarian, Shuyang Gao, Greg Ver Steeg, Aram Galstyan. AAAI Conference on Artificial Intelligence (**AAAI-20**).

Nearly-Unsupervised Hashcode Representations for Relation Extraction. Sahil Garg*, Aram Galstyan, Greg Ver Steeg, Guillermo Cecchi. Empirical Methods in Natural Language Processing (**EMNLP-19**).

Kernelized Hashcode Representations for Relation Extraction. Sahil Garg*, Aram Galstyan, Irina Rish, Guillermo Cecchi, Shuyang Gao. AAAI Conference on Artificial Intelligence (**AAAI-19**).

Neurogenesis-Inspired Dictionary Learning: Online Model Adaption in a Changing World. Sahil Garg*, Irina Rish, Guillermo Cecchi, Aurelie Lozano. International Joint Conference on Artificial Intelligence (**IJCAI-17**).

Extracting Biomolecular Interactions Using Semantic Parsing of Biomedical Text. Sahil Garg*, Aram Galstyan, Ulf Hermjakob, Daniel Marcu. *AAAI* Conference on Artificial Intelligence (**AAAI-16**).

Persistent Monitoring of Stochastic Spatio-temporal Phenomena with a Small Team of Robots. Sahil Garg*, Nora Ayanian. Robotics: Science and Systems (**RSS-14**).

Learning Nonstationary Space-Time Models for Environmental Monitoring. Sahil Garg*, Amarjeet Singh, Fabio Ramos. *AAAI* Conference on Artificial Intelligence (**AAAI-12**).

Workshop Proceedings

Therapeutic Dialogue Modeling via Locality Sensitive Hashing. Sahil Garg*, Guillermo Cecchi, Irina Rish, Shuyang Gao, Greg Ver Steeg, Palash Goyal, Aram Galstyan. Presented in *ICML* 2018 Workshop, AI and Computational Psychology: Theories, Algorithms and Applications (CompPsy 2018).

Dialogue Modeling via Hashing Functions. Sahil Garg*, Guillermo Cecchi, Irina Rish, Shuyang Gao, Greg Ver Steeg, Sarik Ghazarian, Palash Goyal, Aram Galstyan. Proceedings of *IJCAI* 2018 Workshop, Linguistic and Cognitive Approaches to Dialog Agents (LaCATODA 2018).

Neurogenesis-Inspired Dictionary Learning: Online Model Adaption in a Changing World. *Sahil Garg**, Irina Rish, Guillermo Cecchi, Aurelie Lozano. *ICLR* 2017 - Workshop Track.

Efficient Space-Time Modeling for Informative Sensing. *Sahil Garg**, Amarjeet Singh, Fabio Ramos. Proceedings of KDD 2012 Workshop, Knowledge

Discovery from Sensor Data (SensorKDD 2012).

Engineering Skills Python, Matlab, Java, Dot Net, Ruby on Rail, Hibernate, Spring framework, JBoss, SQL Server, MySQL, Oracle, C++, Keras.

Professional Services

Program Committee Member for Conferences in CS

The AAAI Conference on Artificial Intelligence (AAAI)	2017, 2018, 2020, 2021
Neural Information Processing Systems (NeurIPS)	2017, 2018, 2019, 2020
International Conference on Machine Learning (ICML)	2018, 2019, 2020, 2021
International Conference on AI and Statistics (AISTATS)	2019, 2020
International Conference on Learning Representations (ICLR)	2019, 2020, 2021

Reviewer for Journals

Transactions on Pattern Analysis and Machine Intelligence (2020, 2021)
IEEE Robotics and Automation Letters (2019)

Past Research Collaborations IBM Research, MIT, U. of Montreal, MILA, USC, Yale, Icahn School of Medicine at Mount Sinai, NYU, IIIT Delhi.

Research Experience

Icahn School of Medicine at Mount Sinai **Postdoctoral Fellow**
Sept 2019 - present Advisor: Cheryl Corcoran & Guillermo Cecchi
Explored the beautiful field of computational psychiatry to understand the challenges clinical practitioners face, and how machine learning can contribute to the field. Developed machine learning models, interpretative and data-efficient, for research problems in computational psychiatry. Analyzed audio transcripts of open-ended interviews with patients conduced by psychiatrists, for an early diagnosis of psychosis and therapeutic dialogue modeling.
Keywords: computational psychiatry, machine learning, text clustering, dialogue modeling, metaphor detection, diagnosis, interpretative, information theory, sparse modeling.
Collaborators: Anusha Yeshokumar, Irina Rish, Yulia Landa, Adriana Feder, Marianne Goodman, Keren Bachi, David Dorfman, Mary-Catherine George, Mary Sano, Zarina Bilgrami, Cansu Sarac, Shalaila Haas, Jihan Ryu, Elisa Monte, Agnes Norbury, Riaz Shaik, Muhammad Parvaz, Emma Stanislawski, Philip Kamilar-Britt, Kelsey Martin, Rachel Jespersen, Matthew Dobbs, Shaynna Herrera, Mary Kowalchyk, Steve Heisig, William S Stone, Alison Yung, Barnaby Nelson, Romina Mizrahi, Marija Krcmar, Kate Gwyther, Sarmiya Uruthiralingam.

University of Southern California (USC) **Research Assistant**
Mar 2015 - Aug 2019 Advisor: Aram Galstyan
Developed machine learning models, which are computationally scalable, trainable in a robust manner on small sets of labeled examples, applicable to natural language processing for real world problems in healthcare. Managed pipeline of a software deliverable for a multi-million dollar project in relation to personalized cancer treatment, Big Mechanism, sponsored by DARPA.
Keywords: bio-informatics, machine learning, relation extraction, abstract meaning representations (semantic parsing), recurrent neural networks, convolution kernels, robustness, scalability, information theoretic representation learning, nearly unsupervised.
Collaborators: Daniel Marcu, Kevin Knight, Ulf Hermjakob, Andrey Rzhetsky, Jose Luis Ambite, Hrant Khachatrian, Peter Sorger, Prem Natarajan, Gully

Burns, Paul Cohen, Greg Ver Steeg, Shuyang Gao, David Kale.

May 2015 - Mar 2016 Advisor: Aram Galstyan
Information-theoretic modeling of brain fMRI dynamics using CorEx.
Keywords: fMRI, machine learning, information theory, unsupervised representations, interpretive.
Collaborators: Greg Ver Steeg, Fabrizio Pizzagalli, Paul Thompson.

June 2014 - Oct 2015 Advisor: Aram Galstyan
Phase transitions in community detection using CorEx.
Keywords: information theory, unsupervised representations, statistical physics, network science, machine learning.
Collaborators: Greg Ver Steeg, Cristopher Moore.

April 2014 - Sept 2014 Advisor: Aram Galstyan
Generative modeling of complex (so called social) networks and its structural properties like clustering, power law degree distribution, degree correlation, for link prediction, etc.
Keywords: network science, machine learning, generative models, hyperbolic spaces, stochastic variational Bayes, causal inference.
Collaborators: Greg Ver Steeg.

Oct 2013 - April 2014 Advisor: Nora Ayanian
Persistent sensing of environmental phenomena with a team of robotic sensors.
Keywords: spatio-temporal stochastic phenomena, machine learning, Bayesian modeling, nonstationarity, path planning, information theory, kernel functions, multi-robots coordination.

June 2013 - Sept 2013 Advisor: Milind Tambe
Developing computationally scalable game theoretic algorithms for safe-guarding natural resources such as fish in the gulf of Mexico.
Keywords: game theory, reinforcement learning, scalability, spatio-temporal stochastic phenomena.
Collaborators: Albert Jiang, William Haskell, Yundi Qian.

IIIT Delhi **Undergraduate Research Assistant**
April 2011 - May 2013 Advisor: Amarjeet Singh
Learning non-stationary models efficiently for sensing environment dynamics.
Keywords: spatio-temporal stochastic phenomena, nonstationarity, machine learning, path planning, information theory, kernel functions, scalability.
Collaborators: Fabio Ramos.

Research Internship Experience

IBM T. J. Watson Research Center Computational Biology Center
Summers of 2016, 2017 Mentors: Irina Rish & Guillermo Cecchi

June 2016 - present
We investigated computational plausibility of *adult neurogenesis* phenomenon.
Keywords: machine learning, sparse modeling, neuroscience, continual online learning, context switching, unsupervised representations.
Collaborators: Aurelie Lozano, Amit Dhurandhar.

June 2017 - present
We developed an information-theoretic framework for modeling therapeutic dialogues via hash functions.

Keywords: dialog modeling, machine learning, scalable, data-efficient, interpretive, hashcode representations, non-parametric, neural networks, kernel functions.
Collaborators: Shuyang Gao, Palash Goyal, Sarik Ghazarian, Greg Ver Steeg, Aram Galstyan.

Teaching Experience

University of Southern California (USC)
Coordinated Mobile Robotics, Spring 2014 Teaching Advisor: Nora Ayanian

Software Engineering Experience

Snowpal Software Services Co-founder
June 2010 - Dec 2011 Manager: Harman Singh & Krish Palaniappan
Developed a server side application in education domain including database design and a RESTful API.
Contributions: requirement analysis, database design, architecture design, product development, team recruitment & training.
Technology: Ruby on Rails, MySQL, Hibernate, Java.

Commdel, India Software Engineer, Founding Member
Aug 2009 - June 2010 Manager: Srinivasareddy Chennareddy
Developed core module for a software to parse data packets, as per configurable ISO8583 format, into business objects for financial transactions. The software was awarded as the best loyalty program in India, and processes transactions worth more than $7 billion yearly.
Contributions: database design, architecture, product development, client interaction for business understanding, managing production team.
Technology: Java, Dot Net, SQL Server, JBoss.

Global Logic, India Software Engineering Intern
Feb 2009 - Aug 2009 Manager: Atul Srivastava
Developed a software component for subscribing RSS feeds in a user friendly manner with an efficient search utility.
Contributions: database design, architecture design.
Technology: Dot Net, SQL Server.

Graduate Coursework

Artificial Intelligence, Database Systems, Coordinated Mobile Robotics, Machine Learning, Applied Linear Algebra, Estimation Theory, Advanced Analysis of Algorithms, Randomized Algorithms (A), Digital Geometry Processing, Scientific Computing and Visualization.

Educational programs

2015 Complex Systems Summer School, Santa Fe Institute.

Other Accomplishments

99% percentile secured in all India entrance exams IIT-JEE-05 (200k participants) and AIEEE-05 (600k participants).
1st rank secured in C++ skill exams (for online placements in undergrad school) conducted by companies Informatica Business Solutions (CS batch of 80 students), and Global Logic (220 students).

Publications in Computational Psychiatry

Articles
Linking language features to clinical symptoms and multimodal imaging in individuals at clinical high risk for psychosis. Shalaila S. Haas, Gaelle E. Doucet, *Sahil Garg**, Shaynna N. Herrera, Cansu Sarac, Zarina R. Bilgrami, Riaz B. Shaik, and Cheryl M. Corcoran . European Psychiatry (2020).

Negative symptoms and speech pauses in youths at clinical high risk for psychosis. Emma R. Stanislawski, Zarina R. Bilgrami, Cansu Sarac, *Sahil Garg**, Stephen Heisig, Guillermo A. Cecchi, Carla Agurto and Cheryl M. Corcoran. NPJ Schizophrenia (2021).

A case report and first-person account of an individual at risk for psychosis who improved during the COVID-19 pandemic. Shaynna Herrera, Cheryl M. Corcoran, Cansu Sarac, Zarina R. Bilgrami, Matthew Dobbs, Rachel Jespersen, Shalaila Haas, Riaz Shaik, Yulia Landa and *Sahil Garg**. Psychosis (2021).

Conference Presentations
Why & How? Artificial Intelligence for Psychotherapy. Department of Psychiatry, Yale University. Dec, 2019.

Hashcode Representations for Psychiatry. Computational Biology Center, IBM T. J. Watson Research Center, NY. Nov, 2019.

Modeling Psychotherapy Dialogues with Hashcode Representations. New York University. Nov, 2019.

Feeling the Heartbeat of a Psychotherapy Session: A Machine Learning Approach. Technology in Psychiatry Summit (TIPS). Oct, 2019.

Robust Machine Learning for an Early Diagnosis of Psychosis. Technology in Psychiatry Summit (TIPS). Oct, 2019.

Robust & Interpretable Modeling of Natural Language for Healthcare. Columbia University. Sept, 2019.

Feeling the Heartbeat of a Psychotherapy Session: A Machine Learning Approach. McGovern Institute for Brain Research, Massachusetts Institute of Technology. Jan, 2020.
Robust Machine Learning for an Early Diagnosis of Psychosis. Society of Biological Psychiatry (SOBP). April, 2020.

Linguistic Markers of Psychological Resilience in World Trade Center First Responders: A Computer-Based Natural Language Processing Study. Society of Biological Psychiatry (SOBP). April, 2020.

Natural Language Processing Analyses of Written Text Across Stages of Anti-NMDA Receptor Encephalitis. Society of Biological Psychiatry (SOBP). April, 2020.

Automated Detection of Increased Metaphor Usage in Open-ended Speech in Schizophrenia and its Risk States. Society of Biological Psychiatry (SOBP). April, 2020.

Big Data Analysis of Therapy Sessions. Symposium on The Talking Cure: Past, Present and Especially Future. April, 2020. (Invited Speaker)

Harmonization of Language Studies in Schizophrenia and Its Risk States to Early Identification. International Early Psychosis Association (IEPA) Symposium. Sept, 2020.

Research References

Aram Galstyan — galstyan@isi.edu
Research Associate Professor — Univ. of Southern California
Director of AI Division — USC ISI

Irina Rish — irina.rish@mila.quebec
Associate Professor — MILA, Univ. of Montreal

Guillermo A. Cecchi — gcecchi@us.ibm.com
Principal Research Staff Member — IBM T. J. Watson Research Center

Daniel Marcu — marcu@isi.edu
Research Associate Professor — Univ. of Southern California
Director of MT/NLP — Amazon

Kevin Knight — kevin.crawford.knight@gmail.com
Professor — Univ. of Southern California
Chief Scientist for NLP — Didi Chuxing

Greg Ver Steeg — gregv@isi.edu
Research Associate Professor — Univ. of Southern California

Amarjeet Singh — amarjeet@iiitd.ac.in
Assistant Professor — IIIT Delhi
Co-Founder & Chief Technology Officer — Zenatix

Fabio Ramos — fabio.ramos@sydney.edu.au
Professor — Univ. of Sydney

Engineering References

Nitin Gupta — nitin@commdel.net
Co-Founder & Managing Partner — Commdel
Co-Founder & Director- Product & Strategy — Agility MobileForce Solutions
Co-Founder & Director — Core Doc2Info Services
Co-Founder & COO — EasyPymtz

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Co-Founder & Director — Agility MobileForce Solutions
Co-Founder — Core Doc2Info Services
Co-Founder & CTO — EasyPymtz

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VP Products, Digital Marketing & Sales — CG Parivar Group
Founder — Stealth Mode Startup Company
Founder — digi1.co
Co-Founder (exited in 2015) — Agility MobileForce Solutions
Director of Engineering — Commdel

Harman Singh — hpssahni@gmail.com
Senior Software Engineer — Amazon
Co-Founder (exited in 2011) — Snowpal Software Services