Sahil Garg

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Research Interest

I am interested in *problem-oriented research*. In the past, I had worked upon the problem of sensing environmental dynamics using mobile sensors. This helped me build my foundations in *machine learning, information theory, and robotics*. Currently, as part of my thesis work, I am working to build models on cancerous bio-pathways via information extraction from the existing bio-medical literature. In the ongoing struggle to solve this problem, I am exploring the theories in *natural language processing, network science*, as well as machine learning. From a recent internship, I have also developed an interest in the modeling of brain functions that are relevant to psychiatric diseases. In this problem, we explore *dictionary learning* as a computational model for the phenomenon of *neurogenesis* in adult human brains. Additionally, we are also developing a natural language processing tool for assisting psychoanalysis sessions.

Education

University of Southern California (USC) Aug 2013 - Dec 2018 (expected)
PhD Student in Computer Science Advisor: Aram Galstyan

Thapar Institute of Engineering and Technology July 2005 - July 2009
Bachelor of Engineering in Computer Science

Research Experience

University of Southern California (USC)

April 2014 - present Advisor: Aram Galstyan
Data driven modeling of real-world complex systems especially in relevance to the Cancer disease.
One of the primary problems that I have been working upon is the modeling of cancerous bio-pathways for drug discovery (DARPA Big Mechanism project, in collaboration with Daniel Marcu, Kevin Knight, Ulf Hermjakob, and Andrey Rzhetsky). In this problem, we first parse the text from bio-medical literature into Abstract Meaning Representation, i.e. semantic parsing. Then, we have the task of structured inference of information, relevant to the modeling, using the semantic parses. We are exploring techniques such as graph convolution kernels, non-stationary kernels, sampling methods, sparse modeling, information theory, vector space embedding of syntactic/semantic representations, and k-nearest neighbor methods.

I have also had exposure to the following problems: i) brain fMRI dynamics modeling using the correlation explanation (CorEx) technique (information theoretic deep learning); ii) phase transitions in community detection using CorEx (expectation maximization, belief propagation, stochastic block modeling); iii) the joint modeling of network structural properties like clustering, power law degree distribution, degree correlation (hierarchical latent space models, embedding in hyperspace, stochastic variational Bayes, causal inference).

Oct 2013 - April 2014 Advisor: Nora Ayanian
Persistent sensing of environmental phenomena with a team of robotic sensors.
This project involved sub-problems such as: i) the coordinated path planning for multiple mobile sensors in a decentralized manner (velocity obstacles, greedy algorithms, path planning); ii) the adaptive modeling of environmental phenomena (Gaussian processes, MCMC sampling, particle filtering).

June 2013 - Sept 2013 Advisor: Milind Tambe

Developing scalable game theoretic algorithms for securing natural resources. Protecting fish in the gulf of Mexico by developing guarding strategies as per a Stackelberg game formalism (partially observable Markov decision processes, Monte Carlo tree search).

IIIT Delhi

April 2011 - May 2013 Advisor: Amarjeet Singh and Fabio Ramos
Learning non-stationary models efficiently for sensing environment dynamics. We developed algorithms for the efficient learning of non-stationary space-time models which are used for the optimization of environmental sensing of phenomena (convolving of local kernels for nonstationarity, non-separable spatio-temporal covariance).

Research Internship Experience

IBM T. J. Watson Research Center
Yorktown Heights, NY USA Computational Biology Center
May 2016 - Aug 2016 Mentor: Irina Rish & Manager: J. Jeremy Rice

Neuroscience Inspired Machine Learning Collab: Irina Rish, Guillermo Cecchi & Aurelie Lozano
We investigate the computational plausibility of neurogenesis phenomenon, that is known to occur in adult human brains, in the context of machine learning models (online dictionary learning, convex optimization, non-stationary environments).

Computational Assistance for Psychoanalysis Collab: Irina Rish & Guillermo Cecchi
Conducting thousands of psychoanalysis sessions with a single patient over the period of years is a tremendous task for even a human expert. For identifying patterns on the underlying causes of a psychiatric disease, computation can go a long way (the methods for psychoanalysis, structured inference from semantic parses).

Pressure Mat for Parkinson's Disease Collab: Irina Rish, Stephen J. Heisig & Guillermo Cecchi
We investigate into the spatio-temporal modeling of pressure Mat data dynamics for an early detection of Parkinson's disease.

Teaching Experience

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

Publications

Conference Proceedings

Neurogenesis-Inspired Dictionary Learning: Online Model Adaption in a Changing World. Sahil Garg*, Irina Rish, Guillermo Cecchi, Aurelie Lozano. To appear in the proceedings of the Twenty-sixth 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. Proceedings of the Thirtieth *AAAI* Conference on Artificial Intelligence, 2016.

Persistent Monitoring of Stochastic Spatio-temporal Phenomena with a Small Team of Robots. Sahil Garg*, Nora Ayanian. Proceedings of Robotics: Science and Systems X, Berkeley, CA, July 2014.

Learning Nonstationary Space-Time Models for Environmental Monitoring. Sahil

Garg*, Amarjeet Singh, and Fabio Ramos. Proceedings of the Twenty-Sixth *AAAI* Conference on Artificial Intelligence, 2012.

Workshop Proceedings

Efficient Space-Time Modeling for Informative Sensing. *Sahil Garg**, Amarjeet Singh, and Fabio Ramos. Proceedings of the 6th International Workshop on Knowledge Discovery from Sensor Data, a workshop of *KDD'12*.

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

Professional Services

Program Committees: AAAI-17, NIPS-17

Industrial Experience

Snowpal Software Services — Co-founder
June 2010 - Dec 2011 — Manager: Krish Palaniappan
Developed a server side application in education domain including database design and a RESTful API.
Contributions: requirement analysis, database design, architecture design on component level, product development, team recruitment & training.
Technology: Ruby on Rails 3, My SQL 5

Commdel, India — Software Engineer
Aug 2009 - June 2010 — Manager: Srinivasareddy Chennareddy
Developed a component to parse the data packets, as per the configurable ISO8583 format, into business objects for financial transactions. The extended component was awarded as the best loyalty program in India, and processes transactions worth more than $1.2b yearly.
Contributions: database design, architecture design on component level, product development, client interaction for business understanding, managing production team.
Technology: Java 1.5, Dot Net 3.5, SQL Server 2008

Global Logic, India — Software Intern
Feb 2009 - Aug 2009 — Manager: Atul Srivastava
Developed a component for subscribing RSS feeds in a user friendly manner with an efficient search utility.
Contributions: database design, architecture design on component level.
Technology: Dot Net 3.5, SQL Server 2005

Graduate Coursework

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

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).

Academic References	available on request