

PARAG SINGLA

Associate Professor

Dept. of Computer Science and Engineering
Indian Institute of Technology Delhi
Hauz Khas, New Delhi, India 110016

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EMPLOYMENT

- **Associate Professor**
Department of Computer Science and Engineering
Indian Institute of Technology Delhi
New Delhi, India.
Period: August 2018 - *Current*
- **Assistant Professor**
Department of Computer Science and Engineering
Indian Institute of Technology Delhi
New Delhi, India.
Period: December 2011 - July 2018
- **Postdoctoral Fellow**
Department of Computer Science
University of Texas at Austin
Austin, Texas, USA.
Period: January 2010 - September 2011

EDUCATION

- **Doctor of Philosophy**
Department of Computer Science & Engineering
University of Washington, Seattle, WA
Thesis: Markov Logic: Theory, Algorithms and Applications
Graduation: March 2009
CGPA: 3.79/4.00
- **Master of Science**
Department of Computer Science & Engineering
University of Washington, Seattle, WA
Thesis: Collective Record Linkage
Graduation: June 2004
CGPA: 3.79/4.00
- **Bachelor of Technology**
Department of Computer Science & Engineering
Indian Institute of Technology Bombay, India
Thesis: Keyword Search In Databases
Graduation: August 2002
CGPA: 9.44/10.00

RESEARCH INTERESTS

Neuro-Symbolic Reasoning, Machine Learning, Artificial Intelligence.

PUBLICATIONS

JOURNAL:

- Danish Contractor, Barun Patra, Mausam and Parag Singla. Constrained LSTM CRF for Understanding Multi-Sentence Entity-Seeking Questions. *Journal of Natural Language Engineering (JNLE)* (*Under Revision*)
- Mona Gupta, Happy Mittal, Parag Singla, Amitabha Bagchi. Analysis and Characterization of Comparison Shopping Behavior in the Mobile Handset Domain. *Electronics Commerce Research. Vol 17(3) (521-551), 2017. Publisher: Springer.*
- Henry Kautz and Parag Singla. Technical Perspective: Combining Logic and Probability *Communications of the ACM 59(7): 106, 2016. (One Page Article).*
- Dinesh Khandelwal, Kush Bhatia, Chetan Arora and Parag Singla. Lazy Generic Cuts. *CVIU Special Issue on Inference and Learning of Graphical Models, Vol 143 (80-91), 2016. Publisher: Elsevier.*
- Siddharth Bora, Harvineet Singh, Anirban Sen, Amitabha Bagchi and Parag Singla. On the Role of Conductance, Geography and Topology in Predicting Hashtag Virality. *Social Network Analysis and Mining, Vol 5(1):57, 2015. Publisher: Springer.*

CONFERENCE (PEER-REVIEWED):

- Yatin Nandwani, Abhishek Pathak, Mausam, Parag Singla. Primal Dual Formulation For Deep Learning With Constraints. *NeurIPS-19 (to appear).*
- Lovish Madaan, Ankur Sharma, Praneet Khandelwal, Shivank Goel, Parag Singla and Aaditeshwar Seth. Price Forecasting & Anomaly Detection for Agricultural Commodities in India. *COMPASS-19 (52-64).*
- Happy Mittal, Ayush Bhardwaj, Vibhav Gogate and Parag Singla. Domain-Size Aware Markov Logic Networks. *AISTATS-19 (3216-3224).*
- Vishal Sharma, Noman Ahmed Sheikh, Vibhav Gogate and Parag Singla. Lifted Marginal MAP Inference. *UAI-18 (917-926).*
- Gagan Madan, Ankit Anand, Mausam and Parag Singla. Block-Value Symmetries in Probabilistic Graphical Models. *UAI-18 (886-895).*
- Dinesh Khandelwal, Parag Singla and Chetan Arora. Learning Higher Order Potentials for MRFs. *WACV-18 (812-820).*
- Haroun Habeeb, Ankit Anand, Mausam and Parag Singla. Coarse-to-fine Lifted MAP Inference in Computer Vision. *IJCAI-17 (4595-4602).*
- Non-count Symmetries in Boolean and Multi-valued Probabilistic Graphical Models. Ankit Anand, Ritesh Noothigattu, Parag Singla and Mausam. *AISTATS-17 (1541-1549).*
- Contextual Symmetries in Probabilistic Graphical Models. Ankit Anand, Aditya Grover, Mausam and Parag Singla. *IJCAI-16 (3560-3568).*
- Unsupervised Alignment of Actions in Video with Text Descriptions. Young Chol Song, Iftekar Naim, Abdullah Al Mamun, Kaustubh Kulkarni, Parag Singla, Jiebo Luo, Daniel Gidea and Henry Kautz. *IJCAI-16 (2025-2031).*
- Entity Balanced Gaussian pLSA for Automated Comparison. Danish Contractor, Mausam and Parag Singla. *NAACL-16 (69-79).*

- Min Norm Point Algorithm for Higher Order MRF-MAP Inference. Ishant Shanu, Chetan Arora and Parag Singla. *CVPR-16 (5365-5374)*.
- OGA-UCT: On-the-Go Abstractions in UCT. Ankit Anand, Ritesh Noothigattu, Mausam and Parag Singla. *ICAPS-16 (29-37)*.
- Scalable Training of Markov Logic Networks using Approximate Counting. Somdeb Sarkhel, Deepak Venugopal, Tuan Anh Pham, Parag Singla and Vibhav Gogate. *AAAI-16 (1067-1073)*.
- Happy Mittal, Anuj Mahajan, Vibhav Gogate and Parag Singla. Lifted Inference Rules with Constraints. *NIPS-15 (3519-3527)*.
- Tim Kopp, Parag Singla and Henry Kautz. Lifted Symmetry Detection and Breaking for MAP Inference. *NIPS-15 (1315-1323)*.
- Somdeb Sarkhel, Parag Singla and Vibhav Gogate. Fast Lifted MAP Inference via Partitioning. *NIPS-15 (3240-3248)*.
- Ankit Anand, Aditya Grover, Mausam and Parag Singla. ASAP-UCT: Abstraction of State-Action Pairs in UCT. *IJCAI-15 (1509-1515)*.
- Happy Mittal, Prasoon Goyal, Vibhav Gogate and Parag Singla. New Rules for Domain Independent Lifted MAP Inference. *NIPS-14 (649-657)*.
- Somdeb Sarkhel, Deepak Venugopal, Vibhav Gogate and Parag Singla. An Integer Polynomial Programming based Framework for Lifted MAP Inference. *NIPS-14 (3302-3310)*.
- Parag Singla, Aniruddh Nath and Pedro Domingos. Approximate Lifting Techniques for Belief Propagation. *AAAI-14 (2497-2504)*.
- Somdeb Sarkhel, Deepak Venugopal, Parag Singla and Vibhav Gogate. Lifted MAP Inference for Markov Logic Networks. *AISTATS-14 (859-867)*.
- Tivadar Papai, Parag Singla and Henry Kautz. Constraint Propagation for Efficient Inference in Markov Logic. *CP-11 (pp. 691 - 705)*.
- Parag Singla and Raymond J. Mooney. Abductive Markov Logic for Plan Recognition. *AAAI-11 (pp. 1069 - 1075)*.
- Parag Singla and Pedro Domingos. Lifted First-Order Belief Propagation. *AAAI-08 (pp. 1094 - 1099)*.
- Parag Singla and Matthew Richardson. Yes, There is a Correlation - From Social Networks to Personal Behavior on the Web. *WWW-08 (pp. 1 - 7)*.
- Parag Singla and Pedro Domingos. Markov Logic in Infinite Domains. *UAI-07 (pp. 368 - 375)*.
- Parag Singla and Pedro Domingos. Entity Resolution with Markov Logic. *ICDM-06 (pp. 572 - 582)*.
- Parag Singla and Pedro Domingos. Memory-Efficient Inference in Relational Domains. *AAAI-06 (pp. 488 - 493)*.
- Pedro Domingos, Stanley Kok, Hoifung Poon, Matthew Richardson and Parag Singla. Unifying Logical and Statistical AI. *AAAI-06 (pp. 2 - 7)*.
- Parag Singla and Pedro Domingos. Discriminative Training of Markov Logic Networks. *AAAI-05 (pp. 868 - 873)*.
- Parag Singla and Pedro Domingos. Object Identification with Attribute-Mediated Dependences. *PKDD-05 (pp. 297 - 308)*. **Winner of the Best Paper Award.**

BOOK CHAPTERS:

- Sindhu Raghavan, Parag Singla and Raymond J. Mooney. Plan Recognition using Statistical Relational Models. *In Plan, Activity and Intent Recognition: Theory and Practice. Edited by G. Sukthankar, C. Geib, H.H.Bui, D. Pynadath and R.P. Goldman (pp. 57 - 85), 2014.*
- Pedro Domingos, Daniel Lowd, Stanley Kok, Hoifung Poon, Matthew Richardson and Parag Singla. Markov Logic: A Language and Algorithms for Link Mining. *In Link Mining: Models, Algorithms and Applications. Edited by P. Yu, C. Faloutsos and J. Han (pp. 135 - 162), 2010.*
- Pedro Domingos, Stanley Kok, Daniel Lowd, Hoifung Poon, Matthew Richardson and Parag Singla. Markov Logic. *In Probabilistic Inference and Logic Programming. Edited by L. De Raedt, P. Frasconi, K. Kersting and S. Muggleton (pp. 92 - 117), 2008.*
- Pedro Domingos, Daniel Lowd, Stanley Kok, Hoifung Poon, Matthew Richardson and Parag Singla. Just Add Weights: Markov Logic for the Semantic Web. *In Uncertain Reasoning for the Semantic Web I. Edited by P. C. G. Costa, C. d'Amato, N. Fanizzi, K. B. Laskey, K. J. Laskey, T. Lukasiewicz, M. Nickles, and M. Pool (pp. 1 - 25), 2008.*

WORKSHOP AND SHORT PAPERS:

- Danish Contractor, Barun Patra, Mausam, Parag Singla. Understanding Complex Multi-sentence Entity Seeking Questions. *AAAI-19 Workshop on Reasoning and Complex Question-Answering (RCQA), 2019*
- Yatin Nandwani, Ankit Anand, Mausam and Parag Singla. Lifted Inference for Faster Training (LIFT) in End-to-End neural-CRF models. *NeurIPS-18 Workshop on Relational Representation Learning (R2L), 2018.*
- Gagan Madan, Ankit Anand, Mausam and Parag Singla. Block-Value Symmetries in Probabilistic Graphical Models. *IJCAI/ICML-18 Workshop on Statistical Relational AI (StaRAI), 2018.*
- Vishal Sharma, Noman Ahmed Sheikh, Happy Mittal, Vibhav Gogate and Parag Singla. Lifted Marginal MAP Inference. *IJCAI/ICML-18 Workshop on Statistical Relational AI (StaRAI), 2018.*
- Happy Mittal, Ayush Bhardwaj, Vibhav Gogate and Parag Singla. Domain Aware Markov Logic Networks. *IJCAI/ICML-18 Workshop on Statistical Relational AI (StaRAI), 2018.*
- Tim Kopp, Parag Singla and Henry Kautz. Conditional Term Equivalent Symmetry Breaking for SAT. *AAAI-17 Workshop on Symbolic Inference in Optimization*
- Ankit Anand, Aditya Grover, Mausam and Parag Singla. Contextual Symmetries in Probabilistic Graphical Models. *IJCAI-16 Workshop in Statistical Relational AI. **Winner of the Best Paper Award.***
- Happy Mittal, Shubhankar Suman Singha, Vibhav Gogate and Parag Singla. Fine Grained Weight Learning in Markov Logic Networks. *IJCAI-16 Workshop on Statistical Relational AI*
- Tim Kopp, Parag Singla and Henry Kautz. Toward Caching Symmetrical Subtheories for Weighted Model Counting *AAAI-16 Workshop on Beyond NP*
- Tim Kopp, Parag Singla and Henry Kautz. Symmetry Breaking for Relational Model Finding. *IJCAI-15 Workshop on Weighted Logics for Artificial Intelligence.*
- Mona Gupta, Happy Mittal, Parag Singla and Amitabha Bagchi. Characterizing Comparison Shopping Behavior: A Case Study. *Workshop on Big Data Customer Analytics (BDCA), 2014 (Co-located with ICDE-14).*
- Yamuna Prasad, K.K. Biswas and Parag Singla. Feature Selection using One Class SVM: A New Perspective (Poster Paper). *NIPS-13 Workshop on Machine Learning in Computational Biology.*
- Yamuna Prasad, K.K. Biswas and Parag Singla. Scaling-up Quadratic Programming Based Feature Selection (Short Paper). *Late-breaking Track at AAAI-13.*

- Parag Singla, Aniruddh Nath and Pedro Domingos. Approximate Lifted Belief Propagation. *AAAI-10 Workshop on Statistical Relational AI*.
- Parag Singla, Henry Kautz, Jiebo Luo and Andrew Gallagher. Discovery of Social Relationships in Consumer Photo Collections using Markov logic. *CVPR-08 Workshop on Semantic Learning and Applications in Multimedia*.
- Parag and Pedro Domingos. Multi-Relational Record Linkage. *KDD-2004 Workshop on Multi-Relational Data Mining*.
- B. Aditya, Soumen Chakrabarti, Rushi Desai, Arvind Hulgeri, Hrishikesh Karambelkar, Rupesh Nasre, Parag and S. Sudarshan. User Interaction in the BANKS System (Demo Paper). *ICDE-03 (pp. 786 - 788)*.
- B. Aditya, Gaurav Bhalotia, Soumen Chakrabarti, Arvind Hulgeri, Charuta Nakhe, Parag and S. Sudarshan. BANKS: Browsing and Keyword Searching in Relational Databases (Demo Paper). *VLDB-02 (pp. 1083 - 1086)*.

RESEARCH GRANTS

As PI:

- PI: Parag Singla. Co-PI: Mausam.
Title: Question-Answering over Complex Queries
Agency: IBM, USA
Amount: Rs. 9.6 Lakhs
Period: Apr 2018 - Mar 2023.
Status: Ongoing.
- PI: Parag Singla
Tractable Probabilistic Logic Models: A New Deep Explainable Representation.
Agency: DARPA (USA). Sub-contracted through University of Texas Dallas, USA.
Amount: Rs 1.28 Cr.
Period: May 2017 - April 2021.
Status: Ongoing
- PI: Parag Singla. Co-PI: Maya Ramanath.
Mining Opinion from News Sources for Defense Applications.
Agency: Defence Research and Development Organization (DRDO), India.
Funding: Rs 9.8 Lakhs.
Period: Aug 2013 - Mar 2015.
Status: Completed.

As Co-PI:

- PI: Srikanta Bedathur. Co-PI: Parag Singla (and others).
IBM-IITD AI Horizons Networks - Neuro Symbolic Information Systems.
Agency: IBM, USA.
Funding: Rs 4.5 Cr.
Period: Nov 2018 - Oct 2021.
Status: Ongoing.
- PI: Kolin Paul. Co-PI: Parag Singla (and others).
Social Media Analytics for Security (SMACS).
Agency: Govt. of India.
Funding: Rs 8.1 Cr.
Period: Jun 2018 - May 2020.
Status: Ongoing.

- PI: Mausam. Co-PI: Parag Singla.
Probabilistic Inference over Textual Knowledge Bases
Agency: IBM, USA.
Funding: Rs 9.6 Lakhs.
Period: Feb 2018 - Jan 2023.
Ongoing.
- PI: Mausam. Co-PI: Parag Singla.
Research on Knowledge Representation and Extraction of Single Event.
Agency: Korean Advanced Institute of Science and Technology (KAIST), Korea.
Funding: Rs 52.5 Lakhs.
Period: Mar 2014 - Sep 2014.
Status: Completed.

CONSULTANCY

As PI:

- PI: Parag Singla. Co-PI: Mausam.
Machine Learning for Real Estate Prices.
Agency: Info Edge Limited, India.
Funding: Rs 2.50 Lakhs.
Period: May 2017 - Mar 2018.
Status: Completed.

INDUSTRY EXPERIENCE

- Research Sabbatical
Company: Tata Consultancy Services (TCS), Gurgaon & Noida.
Duration: 5 Days, during the period Jun 25, 2013 - Jul 5, 2013.
Agenda: Research Discussions, Collaboration Opportunities.

PRIOR RESEARCH EXPERIENCE

- **University of Texas, Austin** **Jan 10 - Sep 11**
Position: Post-doctoral Research Fellow
Projects:
 - Online learning with partial observability in SRL models
 - SRL models for abductive inference
 - Constraint propagation for inference in SRL models
- **University of Washington, Seattle** **Jan 04 - Dec 08**
Position: Research Assistant
Projects:
 - Algorithms for efficient learning and inference in Markov logic
 - Extending the semantics of Markov logic to infinite domains
 - Application of Markov logic to entity resolution
 - Object-Identification using collective information
- **Kodak Research Labs, Rochester, NY.** **Jun 07 - Aug 07**
Position: Summer Intern.
Project: Discovering social relationships from personal photo collections using Markov logic.

- **Microsoft Research, Redmond, WA.** **Jul 06 - Sep 06**
Position: Summer Intern.
Project: Finding a correlation between the personal behavior of people on the web (i.e. keyword searches, demographics etc.) and their social behavior (i.e. talking characteristics on instant messenger).
- **IIT Bombay, Mumbai** **Jul 01 - Aug 02**
Position: Undergraduate Researcher.
Project: Supporting web like keyword search in databases.
- **IBM India Research Lab, New Delhi, India.** **May 01 - Jul 01**
Position: Summer Intern.
Project: Agglomerative clustering of a set of proper nouns using the features extracted from the web.

TEACHING EXPERIENCE

COURSES PROPOSED, IIT DELHI

Following courses were proposed with help/inputs from other faculty members in the CSE Department.

- Postgraduate Course on “Learning Probabilistic Graphical Models (COL 776)”. Approved by the IIT Delhi Senate as part of the new curriculum (2013).
- Postgraduate Course on “Machine Learning” (COL 774). Approved by the IIT Delhi Senate as part of the new curriculum (2013).
- Undergraduate Course on “Fundamentals of Machine Learning” (CSL 341). Approved by the IIT Delhi Senate (2012).

INSTRUCTOR, DEPT. OF CSE, IIT DELHI

- COL 870: Special Topics in Machine Learning: Reinforcement Learning **ongoing**
- COL 774: Machine Learning. **Spring 19**
- COL 100: Introduction to Computer Science (co-instructor: Sorav Bansal). **Fall 18**
- COL 774: Machine Learning. **Spring 18**
- COL 865: Special Topics in Computer Applications: Deep Learning **Fall 17**
- COL 774: Machine Learning **Spring 17**
- COL 776: Learning Probabilistic Graphical Models **Fall 16**
- COL 774: Machine Learning **Spring 16**
- COL 776: Learning Probabilistic Graphical Models **Fall 15**
- COL 774: Machine Learning **Spring 15**
- CSL 341: Fundamentals of Machine Learning **Spring 14**
- CSL 100: Introduction to Computer Science **Summer 14**
- CSL 864: Special Topics in AI: Probabilistic Graphical Models **Spring 14**
– **Teaching Excellence Award conferred for this course offering**
- CSL 341: Fundamentals of Machine Learning **Fall 13**
- CSL 102: Introduction to Computers and Programming (co-instructor with Huzur Saran) **Spring 13**
- CSL 865: Special Topics in Computer Applications: Machine Learning **Fall 12**

- CSL 102: Introduction to Computer Science (co-instructor with Huzur Saran) **Spring 12**

MENTOR, PROFESSIONAL ETHICS AND SOCIAL RESPONSIBILITY (PESR), IIT DELHI

- NEN 100, NEN 101: Mentored a batch of about 22 first-year students every year. **2013-2017**

TEACHING ASSISTANT, UNIVERSITY OF WASHINGTON, SEATTLE

- CSE P546: Data Mining (Professional Masters) **Fall 04, Spring 03**
- CSE 531: Computability and Complexity (Graduate) **Fall 03**
- CSE 142/143: Computer Programming (Undergraduate) **Winter 03, Fall 02**

TUTORIALS AND INVITED TALKS

Tutorials:

- Markov Logic: Theory, Algorithms and Applications. COMAD 2012, Pune.

Invited Talks:

- StarAI Lab, Dept. of CS, Univ. of California at Los Angeles, Jun 2019.
- Dept. of CS, Univ. of Texas, Dallas, Aug 2018.
- Faculty Development Program, Maharaja Agrasen Institute of Technology (Delhi), 2017.
- Continuous Education Program (CEP), Centre for AI and Robotics, DRDO, Bengaluru, 2016.
- Second Indian Workshop on Machine Learning, IIT Kanpur, 2016.
- Faculty Research Talk Series, Dept. of CSE, IIT Delhi, 2016.
- Indo-Australian Meeting on Modelling Large-scale Linked Data, IIIT Delhi, 2014.
- Guavus (India) - Research and Development, Gurgaon, 2014.
- Indian Institute of Technology Madras, 2013.
- Tata Consultancy Services, Gurgaon, 2013.
- Workshop on Social Computing, IIT Kharagpur, 2012.
- Mysore Workshop on Machine Learning, Mysore, 2012.
- TACTIC's Conference, Tata Consultancy Services, Delhi, 2012.
- Indian Institute of Science, Bangalore, 2011.
- eBay, San Jose, 2011.
- Undergraduate AI class, UT Austin, 2010.
- Microsoft Research Redmond, 2008.
- IBM India Research Lab, Bangalore, 2008.
- Indian Institute of Technology Bombay, 2008.

PATENTS AND SOFTWARE

Patents:

- Matthew Richardson and Parag Singla. Using Joint Communication and Search Data. Microsoft Corporation, Issued April 2012.

- Jiebo Luo, Parag Singla, Henry Kautz and Andrew Gallagher. Discovering Social Relationships in Consumer Photo Collections. Eastman Kodak Company, Issued May 2011.

Software Developed:

- Alchemy: System for Statistical Relational AI.
<http://alchemy.cs.washington.edu>.
(Along with various other contributors.)

PROFESSIONAL ACTIVITIES

- Program Co-chair for ACM India Joint International Conference on Data Science and Management of Data (CoDS-COMAD), 2019.
- Member Journal of Artificial Intelligence Research (JAIR) Editorial Board. *Since June 2016*.
- Senior Program Committee Member IJCAI-ECAI 18, IJCAI 16, IJCAI 11.
- Program Committee Member for AAAI 19, AAAI 15, CoDS (IKDD) 15, KDD 14, CoDS (IKDD) 14, IJCAI 13, AAAI 13, ECAI 12, AAAI 12, PGAI @ AAAI 11.
- Reviewer for
 - Journal of Artificial Intelligence Research (JAIR)
 - IEEE Transactions on Multimedia
 - The Computer Journal
 - Information Systems Research
 - ACM Transactions on Knowledge Discovery from Data
 - Annals of Mathematics and Artificial Intelligence

AWARDS AND ACHIEVEMENTS

- Young Faculty Research Fellowship Awarded under the Visvesvaraya PhD Scheme, Government of India. **2016**
- Winner of the Best Paper Award at IJCAI-16 Workshop on Statistical Relational AI. **2016**
- Teaching Excellence Award Conferred for the Course on “Learning Probabilistic Graphical Models” taught in Spring 2014, IIT Delhi. **2015**
- PhD Thesis nominated by the University of Washington CSE Department for the ACM SIGKDD Dissertation Award. **2009**
- Winner of the Best Paper Award at PKDD-05. **2005**
- In the Joint Entrance Examination for securing admission to the IIT, was placed **Ninety Nine** in India among approximately 100,000 competitive students who took the examination. **1998**
- Recipient of Merit Certificate under National Scholarship Scheme for CBSE (Central Board for Secondary Education) Grade Twelve Examination, India. **1998**
- Ranked **1st** in the whole District for the High School (Grade Ten) Examination, India. **1996**

REFERENCES

- **Pedro Domingos**
Professor,
Department of Computer Science & Engineering,
University of Washington, Seattle, WA, USA.
pedrod@cs.washington.edu

- **Raymond J. Mooney**

Professor,
Department of Computer Science,
University of Texas, Austin, TX, USA.
mooney@cs.utexas.edu

- **Henry Kautz**

Professor,
Department of Computer Science,
University of Rochester, Rochester, NY, USA.
kautz@cs.rochester.edu
