

# Somak Aditya

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## RESEARCH INTERESTS

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My current interests revolve around developing hybrid statistical and symbolic models that can perform higher-level reasoning by leveraging background knowledge. I am deeply motivated by interdisciplinary efforts and I am a believer of the deep potential impacts of the joint efforts of symbolic reasoning and probabilistic modeling in the field of Artificial Intelligence.

## EDUCATION

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*Doctor of Philosophy*, Computer Science **Arizona State University**, Tempe, AZ  
Dissertation Title: Knowledge and Reasoning for Image Understanding 2014-2018  
Advisors: Prof. Chitta Baral, Dr. Yezhou Yang  
GPA 4.0 (out of 4.0)

*Master of Engineering*, Computer Science **Indian Institute of Science**, Bangalore  
Dissertation Title: Generic Incremental K-Means Clustering 2009-2011  
Advisor: Professor M. Narasimha Murty  
GPA 7.3 (out of 8.0), 2<sup>nd</sup> in Class

*Bachelor of Engineering*, Computer Science **Jadavpur University**, Kolkata  
CGPA 8.87 (out of 10), 7<sup>th</sup> in Class 2005-2009

## PROFESSIONAL EXPERIENCE

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*Microsoft Research India* Feb 2020 – Present  
Postdoctoral Researcher  
I am continuing my explorations on how knowledge and reasoning may continue to enrich AI systems; this time on a natural language understanding task with Dr. Monojit Choudhury. My focus is to evaluate, explain and enhance NLI systems under the lens of Logical reasoning.

*Adobe Research India* September 2018 – Feb 2020  
Research Scientist  
As a Research Scientist, I extensively collaborated with other researchers and product managers to understand product needs, formulate research problems that revolves

around business use-cases. Interesting projects included marketing knowledge graph creation, diversity in sequence recommendation, and storytelling from data. My other responsibilities included interviewing interns and incoming researchers, running summer internships, and mentoring research associates.

*Strand Life Sciences Pvt. Ltd., Bangalore*

December 2011 – July 2014

Specialist Software Engineer (III)

Worked in the development of RNA-Seq spliced aligner and the user interface for the project from scratch. This was one of the main features in the Avadis-NGS 1.4 release. I also worked in the algorithm development and implementation of SNP detection in targeted regions, base-quality recalibration and local realignment. I contributed in a number of enhancements and optimizations in different stages of the Avadis-NGS SNP-Detection workflow.

*Yahoo Software Development India Pvt. Ltd., Bangalore*

July 2011 – November 2011

Senior Software Engineer

The team was in charge of creating a website to provide a unifying experience to the advertisers to launch their campaigns across all websites of Yahoo. I worked in the creation of the data model used and a part of the user interface.

## TEACHING EXPERIENCE

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*Teaching Assistant, Department of Computer Science, Arizona State University*      2014 – 2016

- CSE-576 Natural Language Processing, Fall 2015 and 2016 (120 students)
- CSE-471 Introduction To Artificial Intelligence, Spring 2016 (100 students)
- CSE-310 Data Structures and Algorithms, Spring 2015 (150 students)

## INTERNSHIPS

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*Cognitive Analytics, Verisk Analytics, New Jersey*

May 2017-Aug 2017

Cognitive Analytics and Machine Learning Research Intern

Worked under Dr. Maneesh Singh, director of Image and Video Analytics, JDE, Verisk Analytics. Taking a detour from my PhD research, we explored Generative Adversarial Networks, that can utilize knowledge from pre-trained experts, which is aimed to generate complex images that depict situations (objects, actions and objects interacting through actions). I also assisted in several other projects (Visual Semantic Role Labeling, Situational Image Generation using Blender). I also took part in screening incoming Ph.D. candidates for full-time and intern positions.

*IBM India Research Labs, Delhi*

May 2015-Aug 2015

Research Intern, Cognitive System Solutions

Worked in Important Event and Entity Detection from Financial News Articles. I successfully created a reasoning framework based on an automatically constructed Knowledge

Base of Financial Terms from Investopedia and manually created a Gold-standard for evaluating the system.

## ACADEMIC ACHIEVEMENTS

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- **Assistantship 2018** The research assistantship is gifted by Verisk Analytics based on the internship.
- **Fellowship 2016, 2017, 2018** Awarded Partial University Graduate Fellowship from Arizona State University. (\$2k for Spring-2016, \$2.5k for Spring-2017, \$4k for Spring-2018)
- **Fellowship 2014** Awarded CIDSE Doctoral Fellowship from Arizona State University. (\$15000 for 2014-2015. \$30000 in total with assistantships.)
- **Fellowship 2009-11** Awarded MHRD Scholarship for qualifying GATE, 2009 (Rs. 8000 p.m.)
- **GATE 2009** AIR (All India Rank) 15<sup>th</sup> in Graduate Aptitude Test in Engineering (GATE) 2009, entrance exam of the IISc & IITs, in Computer Science & Engineering.
- **WBJEE, 2005** Ranked 105<sup>th</sup> in West Bengal Joint Entrance Examination, 2005 for Engineering Entrance (out of over 50000 candidates)

## Patents

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1. Somak Aditya and Atanu Sinha. [Creating a knowledge graph based on text-based knowledge corpora](#). 2019 (*Pending USPTO 16656163*)
2. Somak Aditya, Kushal Chawla, Sharmila Reddy Nangi, Abhinav Mishra, Bhavy Khatri and Pranil Joshi. Learning to Chat by “Chatting” with a Trained Black-Box Conversational Agent. 2019 (*Filed, P9353-US*)

## Publications

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### Journals

- [1] [Somak Aditya](#), Yezhou Yang, Chitta Baral, Yiannis Aloimonos, and Cornelia Fermüller. “Image Understanding using Vision and Reasoning through Scene Description Graph”. In: *Computer Vision and Image Understanding (CVIU)* (2017). ISSN: 1077-3142. doi: <https://doi.org/10.1016/j.cviu.2017.12.004>.

## Conference Proceedings

- [1] Vishesh Agarwal, Somak Aditya, and Navin Goyal. “Analyzing the Nuances of Transformers’ Polynomial Simplification Abilities”. In: *MATH-AI Workshop*. ICLR. May 2021. URL: <https://www.microsoft.com/en-us/research/publication/polysimp/>.
- [2] Pratik Joshi\*, Somak Aditya\*, Aalok Sathe\*, and Monojit Choudhury. “TaxiNLI: Taking a Ride up the NLU Hill”. In: *CoNLL*. Nov. 2020, pp. 41–55.
- [3] Somak Aditya and Atanu Sinha. “Uncovering Relations for Marketing Knowledge Representations”. In: *StarAI Workshop, AAAI 2020*. 2020.
- [4] Somak Aditya, Rudra Saha, Yezhou Yang, and Chitta Baral. “Spatial knowledge distillation to aid visual reasoning”. In: *2019 IEEE WACV*. IEEE. 2019, pp. 227–235.
- [5] Somak Aditya, Yezhou Yang, and Chitta Baral. “Integrating Knowledge and Reasoning in Image Understanding”. In: *IJCAI, 2019*. 2019.
- [6] Somak Aditya, Yezhou Yang, and Chitta Baral. “Explicit Reasoning over End-to-End Neural Architectures for Visual Question Answering”. In: *AAAI 2018*. 2018.
- [7] Somak Aditya, Yezhou Yang, Chitta Baral, and Yiannis Aloimonos. “Combining knowledge and reasoning through probabilistic soft logic for image puzzle solving”. In: *UAI 2018*. 2018, pp. 238–248.
- [8] Somak Aditya. “Explainable Image Understanding Using Vision and Reasoning”. In: *AAAI 2017 Doctoral Consortium*. AAAI Press, 2017, pp. 5028–5029.
- [9] Somak Aditya, Chitta Baral, Yezhou Yang, Yiannis Aloimonos, and Cornelia Fermuller. “DeepIU: An Architecture for Image Understanding”. In: *Advances of Cognitive Systems*. 2016.
- [10] Somak Aditya, Yezhou Yang, Chitta Baral, Cornelia Fermuller, and Yiannis Aloimonos. “Visual Commonsense for Scene Understanding Using Perception, Semantic Parsing and Reasoning”. In: *2015 AAAI Spring Symposium Series*. 2015.
- [11] Somak Aditya, Chitta Baral, Nguyen H Vo, Joohyung Lee, Jieping Ye, Zaw Naung, Barry Lumpkin, Jenny Hastings, Richard Scherl, Dawn M Sweet, et al. “Recognizing social constructs from textual conversation”. In: *NAACL*. 2015.
- [12] Arpit Sharma, Nguyen H Vo, Somak Aditya, and Chitta Baral. “Towards addressing the winograd schema challenge: building and using a semantic parser and a knowledge hunting module”. In: *IJCAI*. AAAI Press. 2015, pp. 1319–1325.
- [13] Arpit Sharma, Nguyen Vo, Somak Aditya, and Chitta Baral. “Identifying various kinds of event mentions in k-parser output”. In: *EVENTS Workshop, NAACL*. 2015, pp. 82–88.

## Informal Publications

- [ ] Ishan Tarunesh, Somak Aditya, and Monojit Choudhury. “Trusting RoBERTa over BERT: Insights from CheckListing the Natural Language Inference Task”. 2021.
- [1] Somak Aditya, Yezhou Yang, Chitta Baral, Cornelia Fermuller, and Yiannis Aloimonos. “From Images to Sentences through Scene Description Graphs using Commonsense Reasoning and Knowledge”. 2015.

## INVITED TALKS & SEMINARS

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- 📖 *The Interplay between Deep Learning, Logic, and Reasoning* 2021  
CSIR and IEEE SPS Deep Learning Summer School
- 📖 *Explicit Knowledge and Reasoning in the era of Deep Learning* 2021  
IIT Hyderabad CSE Faculty Candidate Seminar
- 📖 *Explicit Knowledge and Reasoning in the era of Deep Learning* 2021  
IIT Kharagpur CSE Faculty Candidate Seminar

## CONFERENCE PRESENTATIONS

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- 📖 *TaxiNLI: Taking a ride up the NLU Hill* 2020  
CoNLL 2020 Talk
- 📖 *Integrating Knowledge and Reasoning in Image Understanding* 2019  
Macau, China, IJCAI 2019 Talk and Poster
- 📖 *Combining Knowledge and Reasoning through Probabilistic Soft Logic for Image Puzzle Solving* 2018  
Monterey, California, UAI 2018 Talk and Poster
- 📖 *Explicit Reasoning over End-to-End Neural Architectures* 2018  
Hilton, New Orleans, Louisiana, AAAI 2018 Technical Talk
- 📖 *Explicit Reasoning over End-to-End Neural Architectures* 2018  
Arizona State University, Tempe, USA, 2018 Southwest Robotics Symposium
- 📖 *Explainable Image Understanding using Vision and Reasoning* 2016  
Hilton Union Square, San Francisco, CA, USA, AAAI 2017 Doctoral Consortium
- 📖 *Visual Commonsense for Scene Understanding Using Perception, Semantic Parsing and Reasoning* 2015  
Stanford University, California, USA, 2015 AAAI Spring Symposium Series

## PROFESSIONAL SERVICES

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- Organizer
  - CIKM 2021: Knowledge Injection in Neural Networks (with colleagues from Intel Labs, University of College London, Arizona State University; <https://sites.google.com/view/kinn2021/>)
  - IJCAI 2021: Is Neuro-symbolic SOTA still a myth for Natural Language Inferencing (with colleagues from IBM Research, KU Leuven, MSR India, UT Austin; <https://nsnli.github.io/>)
  - KR 2018: Integrating learning of Representations and models with deductive Reasoning that leverages Knowledge (<https://sites.google.com/view/r2k2018/home>)
- Panelist: IJCAI 2019 Doctoral Consortium Career Panel

- PC Member: EMNLP, ACL, NAACL, EACL, AAAI (2021); EMNLP, ACL, AAAI, IJCAI (2020);
  - Workshops: MathAI Workshop ICLR 2021, LANTERN-COLING (2020, 2021), Cognitive Vision 2019 (ACS at MIT)
- Conference Reviewer: ACL, AAAI, ICRA (2020), IJCAI (2017, 2016)
- Journal Reviewer: IEEE TIP, AIJ, CVIU, The Visual Computer, Robotics and Autonomous Systems (RAS), Pattern Recognition, Neurocomputing

## PROJECTS (During PostDoc)

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### *Natural Language Inferencing: Evaluation and Enhancement*

Advisors: Dr. Monojit Choudhury

Microsoft Research India

The aim is to propose fine-grained evaluation of Natural Language Inference systems across well-defined Linguistic and Logical capabilities. Through extensive evaluation, we aspire to expose if Neural Network-based systems trained using the current data-driven paradigm is fundamentally insufficient across certain reasoning capabilities, and whether Neuro-symbolic mechanisms can step in to fill the void.

### *Interactive Evaluation and Explanation*

Collaborators: Dr. Monojit Choudhury, Dr. Amit Deshpande

Microsoft Research India

Interactive prover systems provide a framework where verifier and prover interact to find a proof. Such interactive protocols may inspire human-machine interactions to find related errors of language models based on a set of given errors, behavioral performance (such as CheckList report-card) and the model API. Similar interaction can be enabled to find post-hoc example-based explanations.

### *Symbolic Reasoning abilities of Deep Neural Networks*

Collaborators: Dr. Navin Goyal

Microsoft Research India

Automated Theorem Proving and symbolic Mathematics tasks presents very specific well-defined challenges. For example, a step in an integration may involve finding a sub-expression to operate, finding the next operation, and executing the operation on a mathematical expression to output new expression. Transformers and Graph Neural Nets have performed impressively, but there is too much to learn about its strengths and shortcomings. The goal here is to extensively evaluate the state-of-the-art architectures on synthetic symbolic tasks and propose informed enhancements based on the evaluation.

## PROJECTS (During PhD)

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### *Understanding images and videos using a combination of Computer Vision, Statistical and Logical Reasoning*

Advisors: Prof. Chitta Baral, Dr. Yezhou Yang

Arizona State University

Collaborator: Prof. Yiannis Aloimonos

University of Maryland, College Park

i) Solving Image Riddles using Vision and Reasoning, ii) Visual Question Answering us-

ing Deep Learning and Probabilistic Soft Logic, iii) Image Caption Generation Through Knowledge Graphs from Images, iv) Integrating Spatial Knowledge for Visual Reasoning

*Compositional and Generative modeling of Images from text*

Advisors: Dr. Yezhou Yang

Arizona State University

Collaborator: Dr. Maneesh Kr. Singh

Verisk Analytics, New Jersey

The goal of the project is to learn a generative model of natural images that abides by properties of compositionality with respect to an input condition (text or features).

*Building a Knowledge Parser for Formal Representation of English Text*

Advisor: Prof. Chitta Baral

Arizona State University

Parsing Natural Language Text and Creating a Knowledge Graph using a combination of Rule-based and Machine Learning Techniques.

*Integrating Statistical and Logical Approaches in Recognizing Social Constructs from Textual Conversation*

Advisor: Prof. Chitta Baral

Arizona State University

Our goal was to recognize high-level social constructs such as Leadership and Status from textual conversation using an approach that integrates statistical methods and symbolic logic based methods.

## REFERENCES

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**Prof. Chitta Baral**

Professor & Chair

Arizona State University.

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**Prof. Yezhou Yang**

Assistant Professor

Arizona State University.

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**Prof. Yiannis Aloimonos**

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**Dr. Monojit Choudhury**

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