Raghava Mutharaju

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Research Interests

Distributed OWL reasoning, scalable SPARQL querying, applications of OWL reasoning, knowledge representation and large scale data processing.

Education

Ph.D in Computer Science — Jan 2009 – Present
Wright State University, Dayton, OH

Master's in Computer Science — Aug 2004 – June 2006
Motilal Nehru National Institute of Technology
(MNNIT), Allahabad, India

Bachelor's in Computer Science — July 2000 – May 2004
Jawaharlal Nehru Technological University
(JNTU), Hyderabad, India

Industry Experience

IBM T.J. Watson Research Center, NY (June 2015 – Aug 2015)

Worked on ontology modeling and reasoning in the context of social data for situational understanding. I built an ontology for "Protest" data based on tweets, Wikipedia and news articles. Next step is to develop reasoning capabilities based on the ontology and to find out correlations among the tweets.

IBM Research, Dublin, Ireland (June 2013 – Aug 2013)

I worked on distributed reasoning algorithms for description logic EL++. I built on my previous work and added support for nominals, incremental reasoning and dynamic load balancing. Evaluation was done on Dublic city traffic data and the performance is very good.

Alcatel-Lucent Bell Labs, Dublin, Ireland (June 2012 – Aug 2012)

During my summer internship, I worked on scalable SPARQL query processing over large data. We concentrated on efficient distribution of RDF data across a cluster and join processing of triple patterns in the query.

Xerox Research Center, Webster, NY (June 2011 – Aug 2011)

I looked into the current work on temporal modeling and developed a temporal model as well as a reasoning mechanism on top of it. This was done using OWL and SWRL. The model is based on James Allen's temporal operators.

Clark & Parsia LLC, Boston, MA (June 2010 – Aug 2010)

I worked on a parallel implementation of EL+ reasoner using Cray XMT supercomputer, which provides a scalable multithreaded platform with shared memory architecture.

CA Technologies, Hyderabad, India (Aug 2006 – Dec 2008)

I worked on developing prototypes for new product ideas and common components for use within CA. I also worked on a timesheet and resource management tool called Clarity.

Publications

Conference Papers

- **Raghava Mutharaju**, Pascal Hitzler, Prabhaker Mateti, Freddy Lécué. *Distributed and Scalable OWL EL Reasoning*. In: Fabien Gandon and Marta Sabou and Harald Sack and Claudia d'Amato and Philippe Cudré-Mauroux and Antoine Zimmermann (Eds.). Proceedings of the 12th Extended Semantic Web Conference (ESWC 2015), Portoroz, Slovenia, May 31-June 4, 2015. Volume 9088 of Lecture Notes in Computer Science, pages 88-103. Springer, 2015.
- **Raghava Mutharaju**. *Very Large Scale OWL Reasoning Through Distributed Computation*. In: Philippe Cudré-Mauroux et. al., 11th International Semantic Web Conference (ISWC 2012), Boston, MA, USA, Nov 11-15, 2012, pp. 407-414.
- Zhangquan Zhou, Guilin Qi, Chang Liu, Pascal Hitzler, **Raghava Mutharaju**. *Reasoning with Fuzzy-EL+ Ontologies Using MapReduce.* In: De Raedt et. al., ECAI 2012, 20th European Conference on Artificial Intelligence, 27-31 August 2012, Montpellier, France. Frontiers in Artificial Intelligence and Applications, Vol. 242, IOS Press, Amsterdam, 2012, pp. 933-934.
- Satya S. Sahoo, D. Brent Weatherly, **Raghava Mutharaju**, Pramod Anantharam, Amit Sheth, Rick L. Tarleton. *Ontology-driven Provenance Management in eScience: An Application in Parasite Research*. In: Robert Meersman et al., editors, OnTheMove Federated Conferences & Workshops (OTM 2009) – ODBASE 2009, Vilamoura, Algarve-Portugal, Nov 3-5, 2009, volume 5871 of Lecture Notes in Computer Science, pages 992-1009. Springer, 2009.
- Meenakshi Nagarajan, Karthik Gomadam, Amit Sheth, Ajith Ranabahu, **Raghava Mutharaju** and Ashutosh Jadhav. *Spatio-Temporal-Thematic Analysis of Citizen-Sensor Data - Challenges and Experiences*. In Gottfried Vossen et al., editors, Tenth International Conference on Web Information Systems Engineering (WISE 2009), Oct 5-7, Poland, 2009, volume 5802 of Lecture Notes in Computer Science, pages 539-553. Springer, 2009.

Workshop Papers

- **Raghava Mutharaju**, Prabhaker Mateti, and Pascal Hitzler. *Towards a Rule Based Distributed OWL Reasoning Framework*. Proceedings of the 12th OWL Experiences and Directions Workshop (OWLED 2015) co-located with the 14th International Semantic Web Conference (ISWC 2015). To Appear.
- **Raghava Mutharaju**. *Distributed Reasoning over Ontology Streams and Large Knowledge Base*. NSF Data Science Workshop 2015.
- Kasthuri Jayarajah, Shuochao Yao, **Raghava Mutharaju**, Archan Misra, Geeth De Mel, Julie Skipper, Tarek Abdelzaher, and Michael Kolodny. *Social Signal Processing for Real-time Situational Understanding: a Vision and Approach*. Proceedings of the 1st International Workshop on Social Sensing (SocialSens 2015) co-located with the the 12th IEEE International Conference on Mobile Ad hoc and Sensor Systems (IEEE MASS 2015). To Appear. (Invited paper)
- **Raghava Mutharaju,** Pavan Kapanipathi. *Are We Really Standing on the Shoulders of Giants?* In: Anastasia Dimou, Jacco van Ossenbruggen, Miel Vander Sande and Maria-Esther Vidal (Eds.). Proceedings of the 1st International Workshop on Negative or Inconclusive Results in Semantic Web, NoISE 2015, co-located with the 12th Extended Semantic Web Conference (ESWC 2015), Portoroz, Slovenia, June 1st, 2015. CEUR Workshop Proceedings Vol-1435.
- **Raghava Mutharaju**, Pascal Hitzler, Prabhaker Mateti. *Distributed OWL EL Reasoning: The Story So Far*. In: Thorsten Liebig, Achille Fokoue, SSWS 2014, Scalable Semantic Web Knowledge Base Systems. Proceedings of the 10th International Workshop on Scalable Semantic Web Knowledge Base Systems co-located with 13th International Semantic Web Conference (ISWC 2014) Riva del Garda, Italy, October 20, 2014. CEUR Workshop Proceedings Vol-1261, pp. 61-76.
- **Raghava Mutharaju**, Prabhaker Mateti, Pascal Hitzler. *Developing a Distributed Reasoner for the Semantic Web*. In: Ruben Verborgh, Erik Mannens (Eds.), ISWC-

DEV 2014. Proceedings of the ISCW Developers Workshop 2014, co-located with the 13th International Semantic Web Conference (ISWC 2014) Riva del Garda, Italy, October 19, 2014. CEUR Workshop Proceedings Vol-1268, pp. 108-112.

- **Raghava Mutharaju**, Pascal Hitzler, Prabhaker Mateti. *DistEL: A Distributed EL+ Ontology Classifier*. Proceedings of the 9th International Workshop on Scalable Semantic Web Knowledge Base Systems (SSWS 2013), Sydney, Australia, October 21, 2013. CEUR Workshop Proceedings Vol. 1046, pp. 17-32.
- Zhangquan Zhou, Guilin Qi, Chang Liu, Pascal Hitzler, **Raghava Mutharaju**. In: Proceedings of the IJCAI-2013 Workshop on Weighted Logics for Artificial Intelligence, WL4AI-2013, Beijing, China, August 2013, pp. 87-93.
- **Raghava Mutharaju**. *How I Would Like Semantic Web To Be, For My Children*. In: Workshop on Semantic Web in 10 years, co-located with the 11th International Semantic Web Conference (ISWC 2012), Boston, USA, 2012.
- **Raghava Mutharaju**, Frederick Maier, Pascal Hitzler. *A MapReduce Algorithm for EL^+*. In: Volker Haarslev et. al., Proceedings of the 23rd International Workshop on Description Logics (DL2010), Waterloo, Canada, 2010. CEUR Workshop Proceedings Vol. 573, pp. 464-474.

Posters/Demos/Challenges

- **Raghava Mutharaju**, Sherif Sakr, Alessandra Sala, Pascal Hitzler. *D-SPARQ: Distributed, Scalable and Efficient RDF Query Engine*. Proceedings of the International Semantic Web Conference (ISWC 2013) Posters & Demonstrations Track, Sydney, Australia, October 23, 2013. CEUR Workshop Proceedings Vol. 1035, pp. 261-264.
- David Carral, Amit Joshi, Adila Krisnadhi, **Raghava Mutharaju**, Kunal Sengupta, Cong Wang. *Konf Connect*. WWW 2012, Metadata Challenge. 21st International Conference on World Wide Web. April 16-20, 2012, Lyon, France.
- Ashutosh Jadhav, Wenbo Wang, **Raghava Mutharaju**, Pramod Anantharam, Vinh Nyugen, Amit P. Sheth, Karthik Gomadam, Meenakshi Nagarajan, and Ajith Ranabahu. *Twitris: Socially Influenced Browsing*. Semantic Web Challenge 2009, 8th International Semantic Web Conference, Oct. 25-29 2009, Washington, DC, USA.
- **Raghava Mutharaju**, Satya S. Sahoo, D. Brent Weatherly, Pramod Anantharam, Flora Logan, Amit P. Sheth, Rick Tarleton. *Ontology Driven Integration of Biology Experiment Data*. Ohio Collaborative Conference on BioInformatics (OCCBIO 2009), June 14-17, 2009.
- Pramod Anantharam, Satya S. Sahoo, D. Brent Weatherly, Flora Logan, **Raghava Mutharaju**, Amit P. Sheth, Rick Tarleton. *Trykipedia: Collaborative Bio-Ontology Development using Wiki Environment*. Ohio Collaborative Conference on BioInformatics (OCCBIO 2009), June 14-17, 2009.

Technical Reports

- Frederick Maier, **Raghava Mutharaju**, Pascal Hitzler. *Distributed Reasoning with EL^{++} Using MapReduce*. June 2010. Department of Computer Science, Wright State University, Dayton, Ohio.
- **Raghava Mutharaju**, Banshi D. Chaudhary. *Traceability from Use Case to .NET Assembly via Design Patterns*. July 2006. Department of Computer Science, MNNIT, Allahabad, India.

Tutorials/Workshops Organized

- **Diversity++ Workshop**; with Claudia d'Amato, Freddy Lecue, Thomas Narock and Fabian Wirth at the 14th International Semantic Web Conference (ISWC 2015). Workshop website: http://dase.cs.wright.edu/activities/diversity2015
- **AI for Smarter Cities. Hype or reality? A Study in Dublin, Bologna, Miami and Rio**, with Freddy Lecue, Jeff Z. Pan, Jiewen Wu and Pascal Hitzler. In: 29th AAAI

Conference on Artificial Intelligence (AAAI 2015), January 25-30, 2015, Texas, USA.

- **Large Scale Reasoning over Semantic Data**, with Jeff Z. Pan, Ilias Tachmazidis and Guilin Qi. In: 13th International Semantic Web Conference (ISWC 2014), October 19-23, 2014, Riva del Garda, Italy.

Projects

Scalable techniques for Semantic Web Reasoning (Jan 2010 – Present)
In order to come to its full potential, the Semantic Web requires scalable methods for automated reasoning with ontology languages. We develop and apply methods from distributed and parallel computing to achieve the required scalability.

Scalable SPARQL Query Processing (June 2012 – Present)
Large amount of RDF data, ranging in several billion triples is now available as open data. In this project, we develop methods for distributed and scalable SPARQL query processing including efficient join processing and data distribution schemes.

Tcruzi Semantic PSE (March 2009 – Aug 2009)
The data generated by the scientific analysis of the parasite Trypanosoma Cruzi (T.cruzi) is spread across multiple heterogeneous databases. I was involved in the semantic data integration of data spread across multiple databases by converting relational data into RDF which conforms with Parasite Experiment Ontology.

Twitris (June 2009 – Nov 2009)
Twitris is a web application which analyses tweets (from Twitter) along spatial, temporal and thematic dimensions. I was involved in the cleaning and analysis of tweets using Lucene and other statistical techniques. Rewrote all the SQL queries to make them more efficient.

Professional Activities

Program Committee member: uSitu 2016, SSWS 2015, ESWC 2015 Posters & Demos, ESWC 2014 Posters & Demos, SSWS 2014.

External reviewer: DL 2010, ECAI 2010, ISWC 2011, DL 2011, SSWS 2011, JIST 2011, FoIKS 2012, WWW 2012, ESWC 2012, ISWC 2013, JIST 2013, SSWS 2013, ICBO 2013, KR 2014, EKAW 2014, JELIA 2014, RR 2014, ECAI 2014, SWJ 2014, AIMSA 2014, ESWC 2015.

Honors and Awards

- Invitation to attend Cloud and Data Services workshop at IBM T.J. Watson Research Center, NY. December 3-4, 2015.
- Invitation to attend NSF Data Science Workshop 2015 at the University of Washington, Seattle. August 5-7, 2015.
- Amazon AWS Education Grant worth $6012 for a period of 2 years.
- Microsoft Azure Research Award worth $20,000 for 1 year.
- Travel awards for ISWC 2015, AAAI 2015, ISWC 2014, ISWC 2012, RR 2012, and DL 2010.
- Spot award at CA Technologies.

Technical Skills

Programming Languages: Java, C, C++
Semantic Technologies: OWL, RDF, SPARQL
Other Technologies: XML, SQL
Frameworks: Hadoop
NoSQL Stores: Redis, MongoDB, Neo4j, HBase