Pramod Anantharam

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Research Interests

My research interests include Semantic Web, Information Extraction, and knowledge representation and reasoning under uncertainty using Bayesian reasoning and Machine Learning techniques. Specifically, I devise techniques and algorithms for leveraging background knowledge (e.g. ConceptNet5, Linked Open Data, domain ontologies) in building probabilistic graphical models used to deal with heterogeneity, uncertainty, incompleteness, and dynamism in many real-world problems. These algorithms can be applied to areas such as traffic data analytics, healthcare, system health monitoring, and Internet of Things.

Education

Ph.D. in Computer Science and Engineering   May 2009 – Present
Wright State University   Ohio, USA

Bachelor of Engineering in Electrical and Electronics   September 2002 – May 2006
BMS College Of Engineering   Karnataka, India

Research Experience

Research Assistant   March 2010 – Present
Kno.e.sis Center, Wright State University

Current Projects:
kHealth (Knowledge-enabled Healthcare and Data Analytics)
Asthma Management:
- Asthma is a challenging problem due its variability and requires personalized and contextual management. We propose to utilize low cost sensors and mobile devices to minimize asthma attacks in children.
- My research is on understanding various observations and its impact on wheezing control level for Asthma patients. We collect observations spanning personal (e.g., wheezing level), public (e.g., CDC), and population level signals (e.g., report of asthma attacks on twitter).
- I build probabilistic machine learning techniques to build risk assessment models for detecting an impending asthma attack.
- We collaborate with Dayton Children's Hospital for access to doctors and patients.

Sustainability (Data Analytics for Smart Cities)
- Understanding city events and its effect on city infrastructure is crucial for smooth operation.
- Most of the current research in this area is focused on instrumenting a city with sensors and analyze them for decision-making.
- My research is focused on extracting city related events from textual observation steams such as microblogs to provide complementary/corroborative/timely view of city events obtained from sensor observations.
- I'm investigating on the use of declarative knowledge (e.g., event vocabulary, location names) with probabilistic models for understanding city events.

Past Projects:
kHealth: Reducing Preventable Hospital Readmissions in Heart Failure Patients
- I lead this project, where we have build a continuous health monitoring system using domain knowledge to reason over vital observations like heart rate, body temperature, accelerometer, etc. We collaborate with Ohio State Medical Center (Wexner Medical Center) so that our research can be evaluated in a clinical setting.
- Specifically, I use probabilistic reasoning techniques to build personalized risk assessment models that combine continuous observations form Physical-Cyber-Social worlds (e.g., physiological, physical, social, patient history) along with the background knowledge of the domain.
- Our research is prototyped into a mobile application running on android-based phones. The initial version of the application is being deployed for feasibility study.

Trusted Semantic Sensor Web project (Sponsor: Air Force Research Laboratory)
- Research on trust issues in sensor and social networks. (Project page - http://wiki.knoesis.org/index.php/SSW)
- Developed a trust model and serialized it as an OWL-ontology.
- Implemented a reputation system based on beta probability density function and built a prototype to visualize confidence evolution with weather sensor dataset (demo).
- Lead a collaborative project with Electrical Engineering Dept., Wright State University, called SECURE (Semantics Empowered resCUe enviRonmEnt), where we explored use of Semantic Web as a knowledge representation and reasoning framework by a rescue robot. The robot used perception ontology to reason over raw sensor observations to generate human intelligible abstractions (demo).

Twitris (Semantic Social Web Application)
- Contributed during the initial research and development.
- Designed algorithms for fetching relevant multimedia content from various sources based on the event descriptors.

Teaching Assistant   September 2009 – March 2010
C programming lab at the Computer Science Dept.,
Wright State University.

Research Assistant   Feb 2009 – August 2009
Kno.e.sis Center, Wright State University
T.cruzi project (Sponsor: NIH)
- Responsible for Ontology-driven RDF translation of relational data.

- Built a cashed proxy server for distributed execution of SPARQL queries.
- Explored tools like D2RQ engine, Protégé, and other APIs for reading and writing RDF data.

Professional Experience

Summer Intern   *May 2014 – August 2014*
Bosch Research and Technology Center, Pittsburgh, PA

Widespread use mobile devices and availability of sensors has resulted in unprecedented opportunities across many domains. One such opportunity is in leveraging Internet of Things (IoT) environment for assisting people in Do It Yourself (DIY) tasks. I worked on representation of tasks and recommendation of step-by-step instructions to accomplish DIY tasks in IoT environment. Specifically, I proposed a Markov Decision Process (MDP) based approach for task recommendation. I also worked on transforming domain knowledge of tasks (such as complexity and resource requirements) into MDP parameters. My work was deployed as a task recommendation module into a larger IoT middleware designed by Bosch.

Visiting Doctoral Student   *September 2013 – November 2013*
Center for Communications Systems Research (CCSR),
University of Surrey, United Kingdom.

Cities are crippling under immense pressure from increasing people and limited natural resources given that three quarters of the world's population will be living in cities by 2050. A city with intelligent infrastructure would be a boon to its citizens and also facilitate conservation and efficient utilization of natural resources. Many citizens in a city talk about various problems they face and even recommend possible solutions. At CCSR, I worked closely with Dr. Payam Barnaghi on the problem of extracting city related events from social stream such as tweets. My visit was funded by a EU project called CityPulse.

Summer Intern   *June 2012 – September 2012*
IBM Research, Delhi, India.

Traffic is a major challenge in most of the cities around the world for both citizens and decision makers. My research focused on leveraging dynamic SMS updates from city authorities in the city of Delhi to assess its impact on traffic. Further, I worked on updating static schedule of public transport vehicles based on these dynamic updates. The result of my internship work was integrated into a journey planner called IRL-Transit used to provide event aware route recommendation for commuters. My work was awarded the best research showcase (along with two other works) in the poster presentation competition.

Summer Intern   *June 2011 – September 2011*
IBM Research, Delhi, India.

I worked on a project that was part of Smarter Planet initiative and specifically, I worked on ontology evolution problem. The ontology had concepts and relationships describing various systems in a city, e.g. departments and services offered by them. Services offered by different departments may vary from one city to the other. Also, same departments may choose to add or remove new service offerings.

Starting from core ontology, incoming evidences (terms extracted from domain specific documents) were analyzed to evolve the core ontology. There was a disclosure filed for this work and a publication is under review for submission at a conference.

Software Engineer
Hewlett-Packard Global Soft Ltd, Bangalore, India.   *July 2006 – December 2008*

My role was to develop and enhance various software applications involving content management systems. I was responsible for many application migrations that were part of DCC (Data Center Consolidation) project. I was recognized for my contributions in the form of e-awards. Some technical skills gained are shell scripting, Java programming, and use of Documentum for content management applications.

Intern
Honeywell Technology Solutions Lab,   *February 2006 – May 2006*
Bangalore, India.

The goal of this internship was to develop an Internet enabled device that monitored a set of sensors attached to it, reported the sensor observations to a database. A human or an application can use these observations and take appropriate action based on sensor states. The complete implementation of the project was done in C. Some technical skills acquired are microcontroller programming and interfacing with sensors, and modem.

Professional Activities

- PC member, ISWC2015 - Research Track
- PC member, WWW2015 - Web Science Track
- PC member, WWW2015
- PC member, 5th Workshop on Semantics for Smarter Cities, collocated with the 13th International Semantic Web Conference, 2014
- PC member, Second International Workshop on Internet of Things, in Conjunction with CollaborateCom 2014
- PC member, Semantic Sensor Network Workshop, ISWC 2013
- PC member, ISWC 2014
- External reviewer, ESWC 2014
- PC member, The ICSE 2014 Workshop on Inclusive Web Programming
- PC member Hypertext 2014
- PC member WWW2014, Web Science Track
- External reviewer WWW2014
- PC member SSN workshop @ ISWC, 2013
- PC member IEEE iThings2013
- External reviewer, ISWC 2013
- PC member, 3rd International Workshop on Detection, Representation, and Exploitation of Events in the Semantic Web (DeRiVE 2013), ISWC 2013.
- PC member, IJCAI 2013
- External reviewer, AAAI AIW 2013

- External reviewer, WWW2013
- External reviewer, HTS2013
- External reviewer, WWW2012
- External reviewer, EKAW2012
- External reviewer, ER2012

Tutorials

- **Pramod Anantharam**, Amit Sheth, Payam Barnaghi "Data Processing and Semantics for Advanced Internet of Things (IoT) Applications: modeling, annotation, integration, and perception", at the International Conference on Web Intelligence, Mining, and Semantics (WIMS 13).
- Krishnaprasad Thirunarayan and **Pramod Anantharam**, 'Trust Networks: Interpersonal, Sensor, and Social,' In: Proceedings of 2011 International Conference on Collaborative Technologies and Systems (CTS 2011), Philadelphia, Pennsylvania, USA, May 23-27, 2011.

Awards and Recognition

- Invited for the NSF Data Science Workshop through Aug 5-7, 2015, at University of Washington, USA, funded by NSF.
- I was offered the Eric & Wendy Schmidt *Data Science for Social Good* Fellowship for Summer 2014
- A short article on my research appeared on our university newsroom (http://webapp2.wright.edu/web1/newsroom/2013/11/22/researchers-work-with-european-union-gains-international-notice/), Nov 2013.
- Invited for participation in Dagstuhl Seminar on Physical-Cyber-Social Computing (http://www.dagstuhl.de/en/program/calendar/semhp/?semnr=13402), 2013.
- Invited for a fully funded visit to University of Debrecen, Hungary, to talk on Data Analytics for IoT at a Faculty Seminar, October 2013.
- NSF Travel Award for attending the International Semantic Web Conference (ISWC) 2012.
- Best research showcase award (one among 2 other, out of 40 interns) for my internship work at IBM Research, India, in Summer 2012.

Patents

- Co-inventor on 2 US Patent applications being filed by IBM based on internship work.
  1. Assessing Impact of Events on Public Transportation Network
  2. A System and Method for Utility-Based Evolution in a Constrained Ontology

Publications

Journal Papers

- Krishnaprasad Thirunarayan, **Pramod Anantharam**, Cory Henson, and Amit Sheth, Comparative Trust Management with Applications: Bayesian Approaches Emphasis, In the Journal of Future Generation Computer Systems (FGCS), Elsevier, 25 pages, May 2013, http://dx.doi.org/10.1016/j.future.2013.05.006 *[Impact Factor: 2.63]*
- Pramod Anantharam, Payam Barnaghi, Krishnaprasad Thirunarayan, and Amit Sheth. 2015. Extracting city traffic events from social streams. ACM Trans. Intell. Syst. Technol. 6, 4, Article 43 (June 2015), 27 pages. DOI: http://dx.doi.org/10.1145/2717317 [*ACM TIST, 2014 Impact Factor: 9.39*]

Conference Papers

2015
- Tanvi Banerjee, **Pramod Anantharam**, William L. Romine, Larry Lawhorne, Amit Sheth, Evaluating a Potential Commercial Tool for Healthcare Application for People with Dementia , International Conference on Health Informatics and Medical Systems (HIMS), July 27-30, 2015, Las Vegas, USA (Accepted)
- **Pramod Anantharam**, Tanvi Banerjee, Amit Sheth, Krishnaprasad Thirunarayan, Surendra Marupudi, Vaikunth Sridharan, Shalini G. Forbis, Knowledge-driven Personalized Contextual mHealth Service for Asthma Management in Children , IEEE 4th International Conference on Mobile Services, June 27 - July 2, 2015, New York, USA (Accepted)
- Pratikkumar Desai, Amit Sheth, **Pramod Anantharam**, Semantic Gateway as a Service architecture for IoT Interoperability , IEEE 4th International Conference on Mobile Services, June 27 - July 2, 2015, New York, USA (Accepted)

2014
- Amit Sheth, **Pramod Anantharam**, and Krishnaprasad Thirunarayan, kHealth: Proactive Personalized Actionable Information for Better Healthcare, Workshop on Personal Data Analytics in the Internet of Things (PDA@IOT 2014), collocated at VLDB 2014, Hangzhou, China, September 5th, 2014.
- Amit Sheth, **Pramod Anantharam**, Krishnaprasad Thirunarayan, Applications of Multimodal Physical (IoT), Cyber and Social Data for Reliable and Actionable Insights , Second International Workshop on Internet of Things (C-IOT 2014) In conjunction with IEEE CollaborateCom 2014, Oct 22nd, 2014, Miami, Florida.

2013
- **Pramod Anantharam** and Biplav Srivastava. 2013. City Notifications as a Data Source for Traffic Management. In Proceedings of the 20th ITS World Congress 2013, October 14-18, 2013, Tokyo, Japan.
- **Pramod Anantharam**, Biplav Srivastava, and Amit Sheth. 2013. Utility-driven evolution recommender for a constrained ontology. In Proceedings of the 3rd International Conference on Web Intelligence, Mining and Semantics (WIMS '13). ACM, New York, NY, USA, Article 14, 11 pages. DOI=10.1145/2479787.2479794 http://doi.acm.org/10.1145/2479787.2479794

- **Pramod Anantharam**, Payam Barnaghi, and Amit Sheth. 2013. Data processing and semantics for advanced internet of things (IoT) applications: modeling, annotation, integration, and perception. In Proceedings of the 3rd International Conference on Web Intelligence, Mining and Semantics (WIMS '13). ACM, New York, NY, USA, , Article 5 , 5 pages. DOI=10.1145/2479787.2479821 http://doi.acm.org/10.1145/2479787.2479821
- Amit Sheth and **Pramod Anantharam**. 2013. Physical cyber social computing for human experience. In Proceedings of the 3rd International Conference on Web Intelligence, Mining and Semantics (WIMS '13). ACM, New York, NY, USA, , Article 1 , 7 pages. DOI=10.1145/2479787.2479865 http://doi.acm.org/10.1145/2479787.2479865
- **Pramod Anantharam**, Krishnaprasad Thirunarayan, and Amit Sheth, 'Traffic Analytics using Probabilistic Graphical Models Enhanced with Knowledge Bases,' 2nd International Workshop on Analytics for Cyber-Physical Systems (ACS-2013) at SIAM International Conference on Data Mining (SDM13), pp. 13-20, Texas, USA, May 2-4, 2013.
- Amit Sheth, **Pramod Anantharam**, and Cory Henson, 'Physical-Cyber-Social Computing: An Early 21st Century Approach,' IEEE Intelligent Systems, pp. 79-82, Jan./Feb. 2013.

2012
- **Pramod Anantharam**, Krishnaprasad Thirunarayan, and Amit Sheth, 'Topical Anomaly Detection for Twitter Stream', In the Proceedings of ACM Web Science 2012, In Conjunction with NetSci 2012 Evanston, Illinois, June 22-24, 2012.
- **Pramod Anantharam**, Alan Smith, Josh Pschorr, Krishnaprasad Thirunarayan, and Amit Sheth 'Demonstration: Dynamic Sensor Registration and Semantic Processing for ad-hoc MOBile Environments (SemMOB)', In: Proceedings of 5th International Workshop on Semantic Sensor Networks 2012 (SSN 2012), co-located with the 11th International Semantic Web Conference (ISWC 2012), Boston, USA, 2012.

2011
- Pratikkumar Desai, Cory Henson, **Pramod Anantharam**, Amit Sheth, 'SECURE: Semantics Empowered resCUe Environment', In: Proceedings of 4th International Workshop on Semantic Sensor Networks 2011 (SSN 2011), co-located with the 10th International Semantic Web Conference (ISWC 2011), Bonn, Germany, pp. 110-113, 2011.
- Krishnaprasad Thirunarayan and **Pramod Anantharam**, 'Trust Networks: Interpersonal, Sensor, and Social,' In: Proceedings of 2011 International Conference on Collaborative Technologies and Systems (CTS 2011), pp. 13-21, Philadelphia, Pennsylvania, USA, May 23-27, 2011 (invited paper).

2010
- **Pramod Anantharam**, Cory A. Henson, Krishnaprasad Thirunarayan, and Amit P. Sheth, 'Trust Model for Semantic Sensor and Social Networks: A Preliminary Report', In: Proceedings of 2010 National Aerospace & Electronics ConferenceDayton, OH, USA, July 14-16, 2010.
- Krishnaprasad Thirunarayan, **Pramod Anantharam**, Cory A. Henson, Amit P. Sheth, 'Some Trust Issues in Social Networks and Sensor Networks,', In: Proceedings of 2010 International Symposium on Collaborative Technologies and Systems (CTS 2010), Chicago, IL, May 17-21, 2010.
- Ashutosh Jadhav, Hemant Purohit, Pavan Kapanipathi, **Pramod Ananthram**, Ajith Ranabahu, Vinh Nguyen, Pablo Mendes, Gary Alan/Allen Smith, Michael Cooney, and Amit P. Sheth, 'Twitris 2.0 : Semantically Empowered System for Understanding Perceptions From

<u>Social Data'</u> Demo submitted to, 9th International Semantic Web Conference, ISWC 2010, Shanghai, China, November 7-11, 2010.

2009
- Satya S. Sahoo, D. Brent Weatherly, Raghava Mutharaju, **Pramod Anantharam**, Amit P. Sheth, Rick L. Tarleton, <u>'Ontology-driven Provenance Management in eScience: An Application in Parasite Research'</u>, OnTheMove Federated Conferences & Workshops (OTM 2009) - ODBASE& #39;09, Vilamoura, Algarve-Portugal, Nov 03 - 04 - 05, 2009.
- Ashutosh Jadhav, Wenbo Wang, Raghava Mutharaju, **Pramod Anantharam**, Vinh Nyugen, Amit P. Sheth, Karthik Gomadam, Meenakshi Nagarajan, and Ajith Ranabahu, <u>'Twitris: Socially Influenced Browsing'</u> Semantic Web Challenge 2009, 8th International Semantic Web Conference, Oct. 25-29 2009, Washinton, DC, USA.
- **Pramod Anantharam**, Satya S. Sahoo, D. Brent Weatherly, Flora Logan, Raghava Mutharaju, Amit P. Sheth, and Rick Tarleton, 'Trykipedia: Collaborative Bio- Ontology Development using Wiki Environment' Ohio Collaborative Conference on BioInformatics (OCCBIO 2009), June 14-17, 2009.
- Raghava Mutharaju, Satya S. Sahoo, D. Brent Weatherly, **Pramod Anantharam**, Flora Logan, Amit P. Sheth, and Rick Tarleton, 'Ontology Driven Integration of Biology Experiment Data', Ohio Collaborative Conference on BioInformatics (OCCBIO 2009), June 14-17, 2009.

Courses (relevant to my research)

- Probability for Engineers
- Probabilistic Graphical Models
- Discrete Event Modeling
- Knowledge Representation and Semantic Web
- Information Retrieval
- Programming Languages

Technical Skills

- Languages: Matlab/Octave, R, Java, C, Scheme
- Scripting: Python (incl. NumPy, SciPy, Pandas), Bash, PHP
- Semantic Web: RDF, OWL, SPARQL
- Databases: MySQL, Virtuoso, Neo4j

Toy Projects

All these projects were done during my undergrad since autonomous/intelligent machines always fascinated me.
- Automatic street light control system using an LDR (Light Dependent Resistor).
- IR based autonomous robot navigation system using AT89C52 and IR sensor TSOP1738
- Line Tracking Robot using light source and LDR. Controller - PIC 16F84
- Sumo robot to compete at the sumo robot competition at Shastra 2005, IIT Madras, India.

- Numerical lock using a keyboard and an LCD display.
- Intruder email notification system using AT89S52 micro controller.

List of References

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