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Research Interests

My core research interests are centered largely around semantic Web, services computing and the two stand out aspects of Web 2.0, which are: 1) Web as a platform and 2) Harnessing collective intelligence. Specifically, I am interested in modeling and representation, search and ranking, and integration aspects of services. Specific research areas include:

- Representation of Web resources including Semantic enrichment of Web resource descriptions using μ -formats.
- Exploring social networks as a services platform for human computation along with other applications such as targeted content delivery.
- Service integration and composition.
- Data interoperability in service integration.

Education

Wright State University (Relocated in Jan 2007)

Dayton, OH

Ph.D. Computer Science and Engineering; Current GPA:4.0

Jan 2007-2009 (Expected)

- **Ph.D Dissertation:** Design and Distribution of Software in the Web 2.0 and Social networks Era (Working title).

University of Georgia

Athens, GA

Ph.D. Computer Science; Graduating GPA:4.0

Aug 2004- Dec 2006

- Relevant Courses: Semantic Web, Distributed Systems, Computer Networks, Software Engineering, Algorithms, Advanced Databases, Advanced Information Systems, Programming Languages

Sri Satya Sai Institute of Higher Learning

India

Masters in Mathematics; GPA:4.45 out of 5.00

Jun 1999- Mar 2001

- Masters Thesis: Pass the Buck: A Preventive Approach to Congestion Control in ATM Networks
- Relevant Courses: Algebraic Topology, Operating Systems, Computer Networks, Compiler Design, Databases, Systems Programming

Sri Satya Sai Institute of Higher Learning

India

Bachelors in Mathematics; GPA:4.23 out of 5.00

Jun 1996- Mar 1999

- Relevant Courses: Advanced Real Analysis, Graph Theory, Topology, Ordinary and Partial Differential Equations, Vector Algebra

Research Experience

Research Assistant and Student Coordinator

Services Research Lab

kno.e.sis center

Jan 2007-Present.

- Partially funded from Semantics and services enabled problem solving environment for Tcruzi (NHL-BI) and Semdis (NSF)

- Investigated the role of semantic computing techniques in the specification, integration, execution and distribution of services and applications in Web and mobile environments.
- Published 6 peer-reviewed conference and journal papers and 4 invited papers, including two papers in ICWS, one of the top conferences in the area of Services computing with an acceptance rate of 16%.
- Contributed to open source reference implementation for the SAWSDL W3C standard
- Contributed as a volunteer to the IBM Sharable Code project

Research Assistant

LSDIS Lab, University of Georgia

METEOR-S
Aug 2004-Dec 2006.

- Partially funded from Semdis (NSF) and IBM innovation grant
- Investigated the role of Semantic Web Services in enabling dynamic configuration and adaptation of Web processes.
- Published 4 peer-reviewed conference, workshop and journal papers and two invited papers, including one paper in ICSOC and two papers in ICWS (top two conferences in the area of services computing)

Professional Experience

Summer Research Intern

IBM India Research Labs, Bangalore, India

May 2007 - Sep 2007

- Developed an approach to increase component reusability in business process design and development, using model comparison techniques.
- The algorithm was demonstrated as a Rational plugin.

Summer Research Intern

IBM T.J.Watson Research Center, Hawthorne, NY

Advanced Delivery Platforms Group
May 2006 - Sep 2006

- Developed a three tier model to integrate a business process specification, its active instances and the middleware infrastructure.
- The algorithm was implemented as a “mashup” using Google Maps to demonstrate the integration over distributed middleware.

Visiting Researcher

National University of Ireland, Galway

Digital Enterprise Research Institute
Oct 2005 - Dec 2005

- Initiated the effort to integrate the WSMO and WSDL-S frameworks. Designed a framework to incorporate WSDL-S annotations using WSMO ontologies.

Summer Research Intern

IBM T.J.Watson Research Center, Hawthorne, NY

Component Systems Group
May 2004 - Sep 2004

- Implemented the code generation and design framework for Next Generation SOA Middleware.

Software Solutions Analyst

Chennai, India

Photon Infotech Private Limited
May 2001 - Aug 2002

- Led the development effort of automatically porting legacy databases in Fourth Dimension to MS SQL in a distributed database environment.
- Led a team of three in designing and prototyping a Web based query broker. Created an application development framework in Macromedia Flash for writing instructional tutorials.

Grant Proposals

I have contributed extensively to the grant proposals listed below during my Ph.D. In addition to actively participating in the writing process, the results from my research have been used in funded proposals.

- [1] Significantly contributed to the successful IBM Eclipse Innovation Grant (2004). The proposal discussed applications on top of the Eclipse platform to enable semantic annotation of Web services.
- [2] Initiated research and contributed to the writing of successful NSF extension grant (2005). The proposal discussed an approach for process computation using graph based semantic Web operators.
- [3] Significant contribution to Semantics Enabled Networking Systems. Submitted to CISCO (2005). The proposal discussed a middleware framework for semantic annotation of high throughput data.
- [4] Significant contribution to network aware middleware for semantic Web data management. Submitted to NSF (2006). The proposal discussed a large scale distributed semantic middleware for managing large semantic models in RDF.
- [5] Significant contribution to NSF proposal on autonomic Web processes with applications to healthcare (2007). The proposal applied my previous work in the area of semantic Web services to healthcare management.
- [6] The results of my work in the METEOR-S project were used in the successfully funded NIH grant (Semantics and services enabled problem solving environment for Tcruzi) (2008). The objective of this proposal is to create an ontology driven problem solving environment for data integration.
- [7] Significantly contributed to the NSF proposal on citizen sensor Web and social computing. The proposal is under review (2009). In this proposal, we put forth research ideas for analyzing and integrating user generated real time data, using spatio-temporal and thematic semantic models.
- [8] Initiated research in the area of citizen sensor Web and social computing that was part of a funded grant from the Air Force Research Laboratory (2009).

Publications

Peer Reviewed Conference and Workshops

- [1] **Karthik Gomadam**, Ajith Ranabahu, Meenakshi Nagarajan, Kunal Verma and Amit P. Sheth, A Faceted Classification Based Approach to Search and Rank Web APIs, Proceedings of the Sixth International Conference on Web Services, 2008, Beijing, China. *pp: 177-184 (Acceptance Rate: 16%)*.
- [2] Jacek Kopecky, **Karthik Gomadam**, Tomas Vitvar, hRESTS: HTML Microformat for Describing RESTful Web Services and APIs, Proceedings of the 2008 IEEE/WIC/ACM International Conference on Web Intelligence, 2008, Brisbane, Australia. *pp: 619-625 (Acceptance Rate: 19%)*.
- [3] **Karthik Gomadam**, Ajith Ranabahu, Lakshmish Ramaswamy, Kunal Verma and Amit P. Sheth, Mediatability: Estimating the Degree of Human Involvement in XML Schema Mediation, Proceedings of the Second International Conference on Semantic Computing, 2008, Santa Clara, CA. *pp: 394-401*.
- [4] **Karthik Gomadam**, Ajith Ranabahu, Lakshmish Ramaswamy, Kunal Verma and Amit P. Sheth, A Semantic Framework for Identifying Events in a Service Oriented Architecture, Proceedings of the Fifth International Conference on Web Services, 2007, Salt Lake City, UT. *pp: 545-552 (Acceptance Rate: 16%)*.
- [5] Zixin Wu, **Karthik Gomadam**, Ajith Ranabahu, Amit P. Sheth, and John A. Miller, Automatic Composition of Semantic Web Services using Process Mediation, Proceedings of the 9th International Conference on Enterprise Information Systems, 2007, Funchal, Portugal. *pp: 453-461*.

- [6] Nanjangud C. Narendra, Karthikeyan Ponnalagu, **Karthik Gomadam**, Amit P. Sheth: Variation Oriented Service Composition and Adaptation (VOSCA): A Work in Progress, Proceedings of the Fourth International Conference on Services Computing, 2007, Salt Lake City, UT. *pp: 694-696*.
- [7] Douglas Brewer, Sujeeth Thirumalai, **Karthik Gomadam**, Kang Li, Towards an Ontology Driven Spam Filter, ICDE Workshops, 2006, Atlanta, GA.
- [8] Kunal Verma, Prashant Doshi, **Karthik Gomadam**, John A. Miller, Amit P. Sheth: Optimal Adaptation in Web Processes with Coordination Constraints, Proceedings of the Fourth International Conference on Web Services, 2006, Chicago, IL. *pp: 257-264 (Acceptance Rate: 17%)*.
- [9] **Karthik Gomadam**, Kunal Verma, Amit P. Sheth, John A. Miller, Demonstrating Dynamic Configuration and Execution of Web Processes, Proceedings of the Third International Conference on Service Oriented Computing, 2005, Amsterdam, Netherlands. *pp: 502-507 (One of the five demo papers published in the proceedings out of 30)*.
- [10] Ranjit Mulye, John A. Miller, Kunal Verma, **Karthik Gomadam**, Amit P. Sheth, A Semantic Template Based Designer for Web Processes. Proceedings of the Third International Conference on Web Services, 2005, Orlando, FL. *pp: 461-469*.

Journal Publications

- [11] E. Michael Maximilien, Ajith Ranabahu, **Karthik Gomadam**, An Online Platform for Web APIs and Service Mashups, IEEE Internet Computing, 2008, 12(5), *pp. 32-43*.
- [12] **Karthik Gomadam**, Ajith Ranabahu, Zixin Wu, Amit P. Sheth and John A. Miller, A Declarative Programming Approach to Process Composition, To appear in the Springer Series on the Semantic Web Services Challenge.
- [13] Kunal Verma, **Karthik Gomadam**, Prashant Doshi, Amit P. Sheth and John A. Miller, Dynamic Configuration and Adaptation of Web Processes, *under revision for ACM Transaction on the Web*.

Invited Papers and Book Chapters

- [14] Amit P. Sheth, **Karthik Gomadam**, Ajith Ranabahu: Semantics enhanced Services: METEOR-S, SAWSDL and SA-REST, IEEE Data Engineering Bulletin, 2008, 31(3). *pp: 8-12*.
- [15] Jonathan Lathem, **Karthik Gomadam**, Amit P. Sheth, SA-REST and (S)mashups : Adding Semantics to RESTful Services, Proceedings of the First International Conference on Semantic Computing, 2007, Santa Clara, CA. *pp: 469-476*.
- [16] Amit P. Sheth, **Karthik Gomadam**, Jon Lathem: SA-REST: Semantically Interoperable and Easier-to-Use Services and Mashups, IEEE Internet Computing, 2007, 11(6). *pp: 91-94*.
- [17] Amit P. Sheth, **Karthik Gomadam**: The 4 X 4 semantic model - exploiting data, functional, non-functional and execution semantics across business process, workflow, partner services and middleware services tiers, ICEIS (Selected Papers), 2007. *pp: 16-26*.
- [18] Amit P. Sheth, **Karthik Gomadam**: The 4 X 4 semantic model - exploiting data, functional, non-functional and execution semantics across business process, workflow, partner services and middleware services tiers, Proceedings of the Nineteenth International Conference On Enterprise Integration Systems, 2007, Fuchal, Portugal. *pp: 1-4*.
- [19] Amit P. Sheth, Kunal Verma, **Karthik Gomadam**, Semantics to energize the full services spectrum, Communications of the ACM, 2006, 49(7), *pp: 55-61*.
- [20] **Karthik Gomadam**, Kunal Verma, Amit P. Sheth, Ke Li: Keywords, Port Types and Semantics: A Journey in the Land of Web Service Discovery. Semantic Web Services, Processes and Applications, 2006, *pp: 89-105*.

Patents

- [21] Fausto Bernardini, Rong Nickle Chang, Perng Chang-shing, **Karthik Rajagopal Gomadam**, Chunqiang Tang, Tao Tao, Edward Cholchin So and Chun Zhang, System and Method for Determining and Optimizing Resources of a Data Processing System Utilized by a Service Request, Status: Filed.

Research Projects

The overall theme of my research is the idea of services and social computing, enhanced by the use of semantic Web. In the initial stages of my Ph.D, I worked extensively in the area of Semantic Web Services and later moved on to the RESTful and lightweight services paradigm. A significant outcome of my research has been the development of applications in diverse areas such as glycomics, semantic problem solving environment for T-Cruzi, bio-smashups and collaborative scientific environments.

Over the last year, I have been exploring the synergy between services and social computing. Below is a brief description of the various research projects I have been involved in.

• Social Computing and Web

– Modeling

- * **Social Space:** We envision the social space of users (in an explicit network like Facebook or a network created by implicit data connections like Twitter) as a network of service providers - each with their set of capabilities (explicated in their profile and activity information). Given that users have different capabilities / interests in many domains (books, movies, work, research interests), in the social space, we represent each user as a n-dimensional vector, with each dimension capturing an aspect of the user. Further, using shallow domain semantic models, one can expand along each of these dimensions (for example, movies can be further expanded along actors, directors, and genre). This allows us to exploit the domain semantics for tasks such as computing the distance between two users, finding similar users, targeted content delivery, and identifying participants for human computation systems. This work is currently in progress. Social space is being implemented in PHP and Java.

– Citizen Sensor Networks

- * The citizen sensor networks project started as a weekend exercise in familiarizing myself with the Twitter API. Initially using naive text processing techniques, I started to find similar messages from Twitter posts on any topic. Subsequent discussions led to the idea of creating citizen sensor networks, one in which we seek to capture a *trail* from user messages. A significant early outcome of this work is a NSF proposal submission in December and this work was also a part of a successful proposal to Air Force Research Lab. Initial prototyping was done in PHP and Java.

• Lightweight RESTful services

– Representation

- * **SA-REST and hRESTs:** SA-REST is a semantic microformat for adding markups to Web resources. SA-REST defines three constructs for adding semantic markups at different levels of granularity. More information is available at <http://tinyurl.com/sarest>. We extended SA-REST to add markups to Web API description. hRESTs allow users to add domain independent structured service information such as inputs, outputs and operations. SA-REST is currently under development and will be demonstrated in the biosciences domain, with specific applications to services in the TCruzi environment. **Publications:**[2,15,16,17]. Initial prototyping involved javascript and XSLT.

– Discovery and Ranking

- * **APIHut:** APIHut is a searching and ranking framework for Web APIs. APIHut uses natural language processing techniques to enable a more faceted approach for API search.

Along with its search capabilities, APIHut also uses a novel ranking algorithm called Serviut rank, that uses metrics similar to the Page rank for ranking Web APIs. **Publications:**[1]. The system was implemented in Java and built on top of Apache Nutch and Lucene. The alpha version of the software is available at <http://alpha.apihut.com>.

– Integration

- * **Ganja:** Ganja or DOPE-BAR (Dynamic Object Pre-fetching Environment Based on Associations and Relationships) is a framework that allows client side optimizations of Web application hybrids or mashups by pre-fetching objects related to user actions and service associations. In our reference prototype, we created a mashup of Google maps, Google movie search, Facebook and MySpace that demonstrated the value of having client-side semantics. The system was prototyped in javascript, Java and PHP.
- * **Mediatability:** We defined Mediatability as a degree of human involvement in XML schema mediation. It is a quantifiable and computable metric, that estimates the difficulty for a user to mediate between data objects from two services. We also implemented an efficient algorithm based on the popular alpha-beta pruning algorithm. **Publications:**[3]. The system was prototyped in Java.
- * **SMashmaker:** SMashmaker is a declarative and dynamic environment for creating Smart Mashups or SMashups. SMashups are applications described using a high level declarative language and are then made executable during run-time. The actual services are bound to a SMashup during its execution. To address the issue of data mediation, we adopted a social approach for creating reusable data mediation scripts. Coupled with the mediatability metric, the reuse of data mapping scripts will ease the task of data mediation. **Publications:**[11]. SMashmaker has also laid the platform for an open scientific environment in the area of metabolomics research.

• **Semantic Web Services**

– Representation

- * **WSDL-S / SAWSDL:** The W3C standard for Semantic Annotation for WSDL and XML Schema (SAWSDL) matured out of our preliminary work, WSDL-S. In addition to providing conceptual inputs in the development of the standard, I also led and contributed to the development of the reference implementation (SAWSDL4J). **Publications:**[14,19]. The open source implementation was written in Java.

– Discovery and Ranking

- * **Semantics enhanced services registry:** Semantics enhanced services registry (SEMRE) is an UDDI extension to support SAWSDL. The registry extends the UDDI data structures to enable native support for semantics. Unlike a traditional registry model, SEMRE allows users to create rich requirement specifications using semantic templates. **Publications:**20. The open source software is available at <http://tinyurl.com/semre>.

– Configuration and Integration

- * **METEOR-S:** The METEOR-S project investigated the role of semantics in service annotation, discovery, composition, and execution. In this project, I worked on creating a middleware framework that supported run-time binding of partner services to processes, taking into consideration the functional and non-functional requirements. To support autonomy during execution, we built an event identification framework on top of METEOR-S for identifying and relating various run-time events (such as partner service failure, delay in product delivery, etc.) to the requirements of the process. **Publications:**[4,9,10,12,13]. The METEOR-S Middleware was prototyped in Java and was built by extending Apache Axis 2 services middleware.

Professional Activities

[1] Presentations, Talks, and Tutorials

- (a) Next generation services middleware: Semantics to Dynamic Binding, Digital Enterprise Research Institute, Galway, Ireland, November 2005.
- (b) Dynamic binding middleware for Semantic Web Services, IBM T.J. Watson Research Center, Hawthorne, NY, June 2006.
- (c) Event identification and autonomy for the business process middleware, Dagstuhl seminar on Autonomous and Adaptive Web Services, Dagstuhl, Germany, February 2007.
- (d) SAWSDL + Axis2: Making the SOA environment dynamic, Motorola India Research Labs, Bangalore, India, July 2007.
- (e) SAWSDL + Axis2: Making the SOA environment dynamic, IBM India Research Lab, Bangalore, India, July 2007.
- (f) Dynamic and Agile SOA using SAWSDL, Tutorial at Semantic Technology Conference, San Jose, CA, May 2008.
- (g) SA-REST: Using Semantics to Empower RESTful Services and Mashups with Better Interoperability and Mediation, Semantic Technology Conference, San Jose, CA, May 2008.
- (h) APIHut, SMashmaker and AIR: Integration and Service distribution in Web and Mobile Environments, HP Labs, Palo Alto, August 2008.
- (i) hRESTs and SA-REST: bringing semantics to mass Web applications, Lightning round on Semantic Mashups, Semantic Technology Conference, San Jose, CA, June 2009.
- (j) Social Space: Leveraging Semantics for Targeted Content Delivery in Social Networks, Panel on Semantics in Social Networks, Semantic Technology Conference, San Jose, CA, June 2009.

[2] Program Committees and Workshop organizations

- (a) Organized the Special Session on Mobile Semantic Computing at the Second International Conference on Semantic Computing (ICSC 2008)
- (b) Session chair at the International Conference on Semantic Computing (ICSC 2008).
- (c) Program committee memberships
 - The IEEE 24th International Conference on Advanced Information Networking and Application (AINA 2009, 2010)
 - Fifth IEEE International Conference on Service Operations, Logistics and Informatics (SOLI 2009)
 - International Workshop on Dynamic and Declarative Business Processes (2008 and 2009)
 - Advances in Semantics for Web services Workshop (semantics4ws 2006, 2007)
 - Service-Oriented Computing: Agents, Semantics, and Engineering (SOCASE 2007, 2008)
 - Workshop on Web Service Composition and Adaptation (WSCA-2007)
 - International Workshop on Semantic and Dynamic Web Processes (SDWP 2006 and 2007)
 - First International Workshop on Ontologizing Industrial Standards (OIS 2006)
 - Service Discovery on the WWW workshop(sdisco'06)
- (d) External Reviewer: Journal of Web Semantics (2007), IEEE Internet Computing (2006-present), Distributed and Parallel Databases (2009), WWW (2005, 2006), ICWS (2005,2006), SCC (2004, 2005, 2006), ICDE 2006

[3] Collaborators

- IBM Almaden Research Center (Dr. Michael Maximilien)

- HP Labs, Palo Alto (Dr. Sharad Singhal)
- IBM India Research Labs (Dr. Biplav Srivastava)
- Digital Enterprise Research Institute, Galway, Ireland (*Past collaboration*)(Dr. Michal Zaremba)
- Semantic Technology Institute, Austria (Dr. Tomas Vitvar, Jacek Kopecky)

Community Contributions

During my career at kno.e.sis and LSDIS Lab, I have played an active role in giving back to my organization. Some of these include the following:

- [1] Assisted Dr. Amit Sheth in teaching courses in the area of Services Computing, Web Information Systems and Web 3.0. My contributions included the creation of a course curriculum and teaching plan, handling lectures, creating and grading assignments and tests along with mentoring students for their class project.
- [2] Initiated and contributed to the LSDIS ISWC podcast on Semantic Web at ISWC 2006. Interviewed Dr. Tim Berners Lee, Dr. Amit Sheth and Dr. Tom Gruber. These can be downloaded at <http://knoesis.org/library/podcasts/>.
- [3] Mentored three undergraduate, two masters students. The thesis topics were in the areas SA-REST, Social networking and Web 2.0
- [4] Actively contributed in the form of discussions, source code and evaluation setup towards the research of my colleagues in the areas of social networks and content driven advertising.
- [5] Provided assistance in administering two Linux servers including user management, Web and database infrastructure.
- [6] Developed an extensible content management system in PHP. The knoesis Web site is powered by this framework.

Extra Curricular Activities

- [1] I am a Carnatic violinist. I have performed in various concerts in Atlanta and Athens (GA), Raleigh (NC), Cambridge (MA) and Chicago (IL). I also am a part of a fusion band, *Ekam Satyam* (Truth is One).
- [2] I contributed to the relief efforts during the Tsunami in South Asia and to the rescue efforts in the gulf coast area after hurricane Katrina.

Skills

Languages: Java, C, PHP, Ruby, Rails framework, XHTML, CSS, Javascript, MySQL

Operating Systems: Debian and Red Hat Linux; Windows 9x, XP, Vista; Mac OS X

Semantic Web and Web Services: RDF, RDFS, OWL, WSDL, SAWSDL, WS-BPEL

Awards and Accomplishments

- Nominated for outstanding graduate student at Wright State University. (2009) (*decision pending*).
- Elected to the Phi Kappa Phi Honor society. (2008)
- Cash award from IBM for filed patent. (2007)
- Invited to the prestigious Dagstuhl Seminar Series for the seminar on Autonomous and Adaptive Web Services. (2007)

- Interviewed Dr. Tim Berners Lee, as a part of the LSDIS ISWC podcast, during ISWC 2006 at Athens, GA.
- Recognized for my contributions to the Department of Mathematics and Computer Science, Sri Sathya Sai Institute of Higher Learning.(1999)

References

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Other references from the industry (Dr. Rong N. Chang, IBM Research; Dr. Biplav Srivatsava, IBM Research) available on request.