RESEARCH OVERVIEW – UNC GREENSBORO DEPARTMENT OF COMPUTER SCIENCE

The Department of Computer Science at UNC Greensboro has a small but active faculty in a variety of research areas, with well-regarded work that has appeared in leading journals and conferences. The list below is organized faculty by expertise in broad, traditional areas of computer science, and the faculty profiles that follow give more detailed information. For more research labs and publications, see

https://compsci.uncg.edu/research/faculty/

Algorithms and Theory of Computing *Stephen R. Tate* Artificial Intelligence *Nancy Green* Bioinformatics *Prashanti Manda* Data Science and Machine Learning *Prashanti Manda* *Somya Mohanty* *Minjeong Kim* *Shan Suthaharan* Database Systems *Lixin Fu* *Fereidoon Sadri*	Extended Reality *Regis Kopper* Image Processing *Minjeong Kim* Networking *Jing Deng* *Shan Suthaharan* Online Social Networks *Jing Deng* *Lixin Fu* *Fereidoon Sadri* Security and Cryptography *Jing Deng* *Shan Suthaharan* *Stephen R. Tate*

Jing Deng

Primary Research Areas: Online Social Networks, Wireless Networks, and Network Security

Other Expertise: Information Assurance, Network Fairness

Brief Overview: Prof. Deng's research is focused on efficient and secure algorithms for online social networks and wireless networks. There are mainly two issues in these networks, especially resource constrained ones: First, how can the information be efficiently delivered from source to destination? Secondly, how secure can such information delivery be when there are node failures, compromise, and captures? In recent research, Prof. Deng has worked on medium access control in wireless networks, information delivery in wireless sensor networks, key establishment in wireless networks, and secure routing in mobile networks.

Other recent projects of Prof. Deng have included zombie user detection and wireless rechargeable networks.

Lixin Fu

Primary Research Areas: Databases, Data Warehousing, and Data Mining

Brief Overview: In data warehousing, a large amount of data from different sources are extracted, cleansed, and integrated into a large storage area. There are a lot of research activities that involve this backend of warehousing, and Prof. Fu's research focuses on the front-end, investigating issues such as representation and efficient algorithms for complicated queries. Prof. Fu has successfully designed several efficient data cube algorithms.

Prof. Fu is investigating combining data mining and data cube, two important fields, resulting in an integrated information system that has more efficiency and capabilities. Initial results such as classification and clustering on data cubes are promising. Dr. Fu works on delivery networks, social networks, and recommendation algorithms. In particular, he is interested in the structure and dynamic features of social networks and in community clustering.

Nancy Green

Primary Research Areas: Artificial Intelligence (natural language processing and generation, computational models of argumentation and rhetoric), AI and Software Engineering Ethics

Other Expertise: Human-Computer Interaction (intelligent multimedia systems)

Brief Overview: Prof. Green's research has covered a number of areas in AI that relate to natural language and graphical communication. Her current main interest is in computational models of argumentation and rhetoric, which encompasses

- Annotation of rhetorical figures in science policy arguments;
- Argumentation schemes for AI and Software Engineering Ethics;
- Argument diagraming tools for AI Ethics and International Studies;
- Argument "mining": automatically extracting arguments from biomedical/biological research articles;
- Argument generation: automatically producing arguments to help patients understand the reasoning underlying the diagnosis of their condition by healthcare professionals (funded by National Science Foundation CAREER Award);
- Argument diagramming systems for "learning how to argue" that use a computational model of argumentation to evaluate a student's arguments and to provide intelligent feedback.

Minjeong Kim

Primary Research Areas: Biomedical Image Analysis, Image Processing, Machine/Deep Learning for imaging data, Brain connectome

Other Expertise: Computational Neuroscience

Brief Overview: Dr. Kim's research interests are mainly in developing cutting-edge image analysis methods for the interdisciplinary field between computer science and biomedicine. Imaging data has become the most powerful tool in biomedicine due to the advancement of high-resolution imaging technology and the increasing variety of imaging modalities. She aims to apply state-of-the-art computer science technologies, for example, machine/deep learning, pattern recognition, computer vision, visualization, and graph theory, to various clinical and preclinical research imaging data to study biomedical fundamentals from computer scientists' view. Such techniques can be adapted to healthcare practices and biomedical research for automated image reading/quantification, computer-assisted diagnosis at an earlier time as well as predictive modeling for clinical outcome.

Regis Kopper

Primary Research Areas: Extended Reality Interfaces, Virtual Reality, Augmented Reality, Human-Centered Design, Human-Computer Interaction

Brief Overview: Dr. Kopper's research centers around extended reality (XR) user experience, Virtual Reality (VR) simulation and applied XR research. Specifically, he works on improving the usability of virtual and augmented reality systems by designing novel interaction techniques, mitigating visually induced motion sickness and integrating tangible devices onto XR user interfaces. On virtual reality simulation, Dr. Kopper works on the design, VR prototyping and evaluation of next generation user interfaces for the assessment of technology that is not yet available in the market, particularly in the public safety domain. His research is also transdisciplinary and collaborative, where he investigates the employment of XR interfaces in areas such as health care, neuroscience, and the humanities.

RESEARCH OVERVIEW – UNC GREENSBORO DEPARTMENT OF COMPUTER SCIENCE

Prashanti Manda

Primary Research Areas: Bioinformatics, Natural Language Processing, Ontologies

Other Expertise: Semantic Similarity, Machine Learning, Data Mining

Brief Overview: Dr. Manda's research is focused on developing algorithms for analyzing disparate kinds of biological data to answer domain-driven questions. Her work is primarily focused on semantically aware biological data described using ontologies. She has developed methods to mine cross-ontology relationships between ontologies and used semantic similarity techniques to compare biological phenotypes for understanding the genetic bases of evolutionary transitions. Her lab is currently focused on developing natural language processing methods based on deep learning to automatically read scientific literature and annotate them with biological concepts from appropriate ontologies.

Somya Mohanty

Primary Research Areas: Machine Learning, Data Science, Cyber-Security, and Trustworthy Computing

Other Expertise: Big Data Compute, Large Scale Databases, Network Security, Social Networks

Brief Overview: Dr. Mohanty's research interests are the development of new methods, algorithms, and systems applicable for mining, analyzing, and visualizing large-scale complex datasets ("Big Data"). Specifically, his research focuses on development of predictive models and novel algorithms for real-time analysis in very high-throughput systems, and creating decision engines based on such systems. The research efforts has found its applicability in a wide range of areas such as predicting the states of network traffic in internet scale models, understanding natural language in structured and unstructured text, leveraging the utility of social media during disaster events, and developing a deeper understanding of patient health using electronic medical records. Apart from the data driven research, Dr. Mohanty is also working on research which involves assuring privacy and security in information/compute systems by developing efficient trusted platforms.

Fereidoon Sadri

Primary Research Areas: Database Systems and Information Integration

Brief Overview: Prof. Sadri's research has included work in modeling and management of uncertain information in database systems, addressing the handling of inaccurate information in databases. Data is often uncertain, in particular when it is obtained by means of data mining and automated information extraction. Prof. Sadri has developed an approach which is based on solid mathematical probability theory for the representation of inaccurate data and query processing for uncertain data. In other work, Prof. Sadri has investigated issues related to multi-database systems, developing powerful database query languages that allow data/metadata transformation (such as the pivot and unpivot operations), and studying query optimization for these languages. This research forms the basis for interoperability among multiple database systems with different schemas.

In Prof. Sadri's work on information integration from multiple sources, he considers the need for scalable decentralized data sharing which arises naturally in a wide range of applications, including enterprise data management, scientific projects undertaken across universities or research labs in biology, astronomy, and other domains, and data sharing among governmental databases. We have developed a framework and have implemented a system for a simple, intuitive, and efficient user interface to query a possibly large number of information sources without any knowledge of data representation details in these sources.

Prof. Sadri's most recent research has been on high-speed parallel processing of very large volumes of data using the "Map-Reduce" technique that was introduced by Google. In this approach, data is partitioned among large numbers (tens or even hundreds of thousands) of desktop computers that collectively process the data efficiently.

Shan Suthaharan

Primary Research Areas: Big Data Analytics and Machine Learning, Big Data Privacy and Security, Computational Modeling, Bayesian Inference and Optimization, and Cognitive Computing.

Other Expertise: Image Analysis and Pattern Recognition, Image/Video Coding and Compression, Image/Video Watermarking and Image/Video Visual Quality Metric.

Brief Overview: Dr. Suthaharan's research interests fall predominantly under the state-of-the-art themes of big data analytics and machine learning. In big data analytics research, he studies various data characteristics — data heterogeneity, complexity, scalability, and unpredictability — of big data for extracting knowledge to understand the data source that produced the big data. In machine learning research, Dr. Suthaharan studies advanced mathematical, statistical, and computational techniques to formulate efficient machine learning models and algorithms that can help accomplish big data analytics research. His research includes the selection and optimization of hyperparameters of machine learning models using Bayesian analysis to make machine learning highly usable in big data analytics in interdisciplinary settings. Dr. Suthaharan is also interested in exploring software engineering models and designs to support big data analytics and machine learning research. One of his current and major research areas is in ophthalmic data science and machine learning.

Stephen R. Tate

Primary Research Areas: Cryptography and Computer Security

Other Expertise: Algorithms, Data Compression, and Theoretical Computer Science

Brief Overview: Prof. Tate's recent research is focused on the following question: What additional capabilities are enabled when standard computing systems are augmented with simple secure hardware additions, such as the Trusted Platform Module being included in many current systems. In his recent research, Prof. Tate has shown how such augmented systems can be used to solve several problems that are provably impossible on standard systems, including realization of a "random oracle" and a non-interactive form of secure mobile agents.

Other recent projects have included new techniques for online/offline digital signatures (digital signatures in which most of the signature can be "pre-computed" before the message to be signed is known, followed by a super-efficient computation once the message is known), and intrusion detection techniques for encrypted protocols.