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 information, including links to project web sites and publications, see

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

Algorithms and Theory of Computing
- *Stephen R. Tate*
- *Chunjiang Zhu*

Artificial Intelligence
- *Chunjiang Zhu*

Data Science and Machine Learning
- *Minjeong Kim*
- *Yingcheng Sun*
- *Shan Suthaharan*
- *Qianqian Tong*
- *Chunjiang Zhu*

Database Systems
- *Lixin Fu*
- *Chunjiang Zhu*

Extended Reality
- *Regis Kopper*

Image Processing
- *Minjeong Kim*

Networking
- *Jing Deng*
- *Shan Suthaharan*

Online Social Networks
- *Jing Deng*
- *Lixin Fu*

Security and Cryptography
- *Jing Deng*
- *Shan Suthaharan*
- *Stephen R. Tate*

Jing Deng

Research Areas: Wireless Networks and Security, Online Social Networks, Mobile Edge Computing

Brief Overview: Prof. Deng's research is focused on efficient and secure algorithms for wireless networks. There are mainly two issues in wireless 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 service look-up in large wireless networks, efficient data forwarding, scheduling in wireless networks, and online social sentiment analysis.

Lixin Fu

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 back-end 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 of the most important fields in database systems, resulting in an integrated information system that has more efficiency and capabilities. Initial results such as classification and clustering on data cubes are promising.

Minjeong Kim

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

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.

Yingcheng Sun

Research Areas: Information Retrieval, Natural Language Processing, Biomedical Informatics, Machine Learning

Brief Overview: Dr. Sun' research interests span the topics of information retrieval, machine learning, and Natural Language Processing, with applications in clinical informatics to solve important healthcare problems. Dr. Sun' overall research goal is to build user- centered intelligent information retrieval systems to leverage the vast amounts of data for improving healthcare for meaningful purposes. He developed novel text mining algorithms and heterogeneous information networks to understand query intents, online discussions and review opinions. He applied information retrieval
frameworks with enhanced user-system interaction on clinical study recommendations for prospective patients, clinical trial design optimization using electronic health records and medical evidence retrieval and synthesis. Working with clinicians from various hospitals including Rhode Island Hospital, Columbia University Irving Medical Center and University Hospitals Cleveland Medical Center, his systems have been evaluated and deployed.

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

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, 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.

Qianqian Tong

Primary Research Areas: Machine Learning, Stochastic Optimization, Deep Learning and Federated Learning, Differential Privacy, Sparse Learning; Graph Convolutional Network (GCN)

Brief Overview: Dr. Tong's research interests span the areas of stochastic optimizations, sparse learning, federated learning, and privacy-preserving machine learning. Dr. Tong mainly developed new machine learning algorithms, such as efficient sparse learning algorithms, parallel stochastic second-order algorithm, efficient Adam algorithms, and federated learning algorithms. Her goal is to develop efficient and privacy-preserving optimization algorithms for deep learning and federated learning, including communication-efficient distributed algorithms, decentralized algorithms, and federated algorithms.

Other recent projects have designed a new deep graph learning method to improve drug discovery & precision medicine; and propose a tensor-based model with quadratic inference function to analyze multidimensional data.

Chunjiang Zhu

Primary Research Areas: Graph Algorithms and Machine Learning, Database Systems, AI for Drug Discovery, and Theoretical Computer Science

Brief Overview: Prof. Zhu has been using theory, principles, and methods in algorithm design,particularly graph algorithm design to solve problems in many other areas, for example, machine learning, drug discovery and development, and cyber-physical systems. Specifically, Dr. Zhu has worked on dynamic graph learning and optimization problems for machine learning and artificial intelligence, and designed graph structures such as spectral sparsifiers and graph spanners and systems to support various types of queries in graphs. For drug discovery, he has studied graph-based indexing algorithms for accelerating chemical similarity search, and designed benchmarking on the several advanced indexing algorithms. Earlier, he also designed healthcare cyber-physical systems, and data structures and algorithms in advanced memory chips.