SPRING 2020

THE UNIVERSITY OF MEMPHIS®

COMPUTER SCIENCE **NEWS**

News from the Department of Computer Science

CHAIR'S MESSAGE

I'm excited that the department continues to grow, with the addition of Assistant Professor Amy Cook last year and searches currently underway for another tenure track assistant professor and a Chair of Excellence in smart and autonomous systems. Our faculty have maintained their track record of receiving research funding for their projects. Over the past year, Professor Vasile Rus and Assistant Professor Deepak Venugopal were awarded a $2.58 million NSF grant to begin a Learner Data Institute and Assistant Professor Thomas Watson received a prestigious NSF CAREER award to investigate applications of theoretical computer science toward communication complexity. Assistant Professor Xing Gao has been awarded his first NSF grant and had a paper accepted to the prestigious CVPR conference. Meanwhile, our student enrollment has grown significantly over the past two years and we now have more than 400 undergraduates and nearly 100 graduate students. Our degree production is also on the rise; and we awarded 48 BS degrees in 2018-19 – a record high in the history of the department. I look forward to sustaining this path as we enter the new decade.

Lan Wang
Professor and Chair

WELCOME NEW FACULTY

Amy Cook joined the CS faculty as a tenure track assistant professor starting in the 2019-20 academic year. Cook completed her PhD in Human-Computer Interaction from Carnegie Mellon University, where she was co-advised by Jessica Hammer (CMU) and Steven Dow (UCSD). Her research focuses on how technology can impact student interactions during class.

DR. TOM WATSON Receives Prestigious NSF Early CAREER Award

The NSF Early Career is among the most prestigious research awards available to junior faculty and provides a jump start to long and productive research careers. Dr. Thomas Watson, assistant professor of Computer Science, was awarded for his project "Structural Communication Complexity," a project that will develop deep technical tools to make progress on several longstanding problems and central issues in communication complexity and its various application areas. The unifying theme of this project is the importation of insights and techniques from structural complexity, which is the area of theoretical computer science devoted to classifying problems according to their inherent computational difficulty.

The field of communication complexity is about situations where two parties, call them Alice and Bob, each hold a separate piece of data, and they wish to collaboratively solve some computational problem that depends on both their inputs. How much will they need to communicate back and forth to achieve their goal? The field encompasses both upper bounds—i.e., the design of protocols that allow Alice and Bob to succeed using only a small amount of communication—as well as lower bounds—which show that no such efficient protocol exists for certain problems (i.e., Alice and Bob will need to communicate many bits to succeed). This serves as a natural model of distributed computing, motivated by big data and cloud computing concerns. More generally, it can be used to model any situation where flow of information between different components of a system forms a bottleneck. For this reason, communication complexity has applications to many other areas of computer science. For more information on his research, contact Watson at thomas.watson@memphis.edu.

PROFESSOR VASILE RUS RECEIVES $2.58 MILLION GRANT TO BEGIN LEARNER DATA INSTITUTE

Led by **Professor Vasile Rus** with co-PI **Assistant Professor Deepak Venugopal** and funded by the National Science Foundation, this project will lay the foundation for a future Learner Data Institute (LDI). Its mission will be to harness the data revolution to further our understanding of how people learn, how to improve adaptive instructional systems (AISs) and how to improve the learning ecosystem's effectiveness and cost efficiency as well as the learners' and instructors' engagement and satisfaction while learning with technology.

LDI will accomplish its mission to transform the education ecosystem by focusing primarily on both online learning with AISs and classroom environments in which AISs are blended in traditional classroom teaching and learning (blended learning). LDI will build on previous efforts and cyberlearning infrastructure such as the LearnSphere/DataShop project, Carnegie Learning's platforms and school integration processes, SPLICE (Standards, Protocols and Learning Infrastructure for Computing Education) and GIFT (Generalized Intelligent Framework for Tutoring).

The two-year conceptualization phase will focus on building a strong community of researchers, define research priorities and develop interdisciplinary prototype solutions that address critical student learning, cyberlearning and learning engineering challenges. The interdisciplinary team from academia, industry and government will work toward building a framework that will facilitate science convergence to accomplish this mission. It will also address core educational tasks in the context of online and blended learning environments. The proposed data science methods and models are generally applicable to other instructional contexts as well as other science and engineering areas.

Carnegie Learning is a developer of commercial-grade adaptive systems and related curriculum products, currently serving more than 400,000 students (primarily in grades 6-12) in more than 2,000 school districts across the U.S. every year.

This project will involve 40 individuals, including six PhD students, and began on Jan. 1, 2020.

Dr. Vasile Rus

Dr. Deepak Venugopal

PROFESSORS RUS AND FLEMING CO-PIS ON $3.4M NSF GRANT

Professor Vasile Rus and **Associate Professor Scott Fleming** are co-PIs on a new $3.4 million grant from the National Science Foundation's Improving Undergraduate STEM Education (IUSE) program.

The project, "Advancing the Science of Learning Data Science with Adaptive Learning for Future Workforce Development," will develop an AI-enabled data science tutor that can be integrated into JupyterLab, an established professional data science tool. The tutor will provide 250 hours of training content.

Expected to last until the end of 2024, the project is led by PI Professor Andrew Olney from the UofM's Institute for Intelligent Systems (IIS). It is an interdisciplinary effort among the IIS, Department of Computer Science, Department of Mathematical Sciences (Professor Dale Bowman) and Department of Instruction and Curriculum Leadership (Professor Andrew Tawfik).

More information can be found on the NSF award abstract at **nsf.gov/awardsearch/showAward?AWD_ID=1918751**

SILICON VALLEY STARTUP LICENSES PATENT

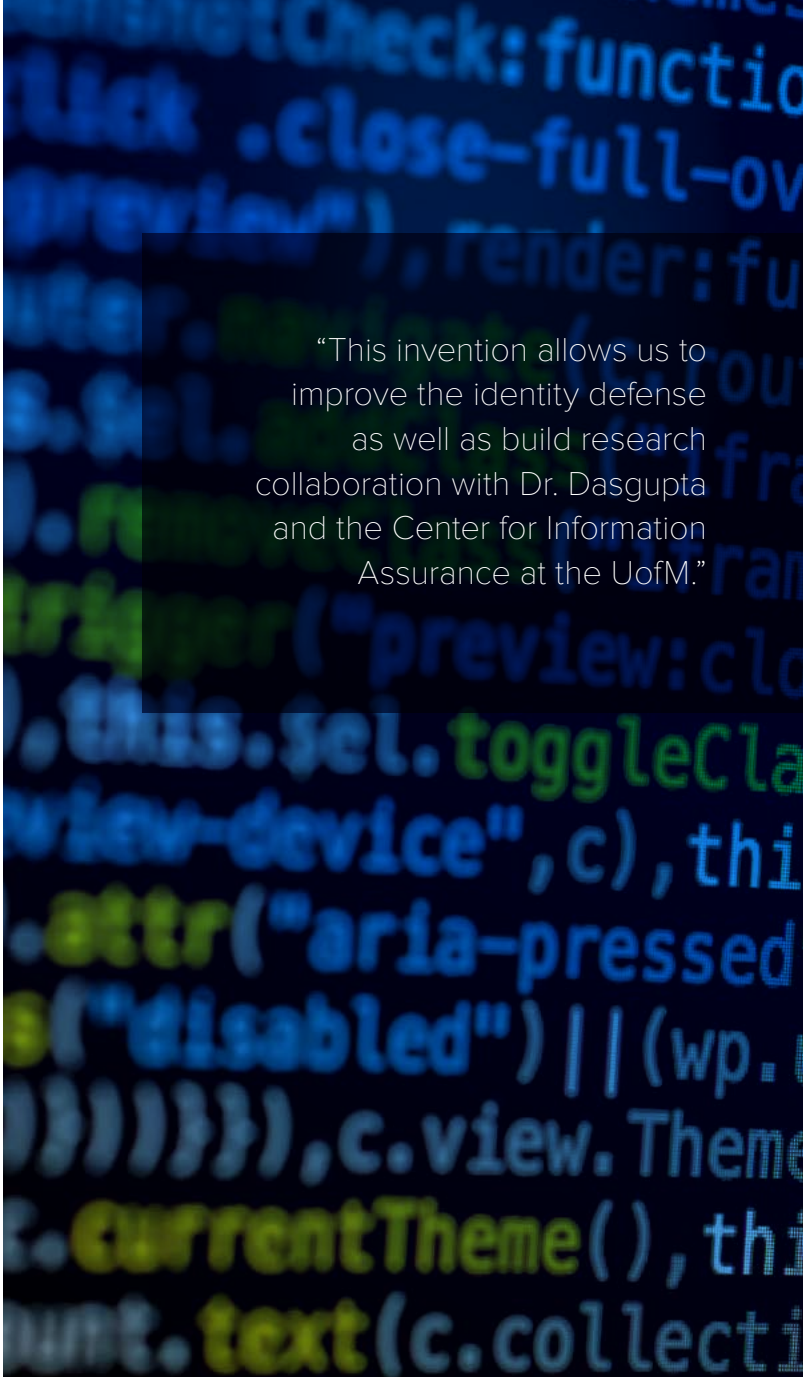
FOR ADAPTIVE MULTI-FACTOR AUTHENTICATION SYSTEM

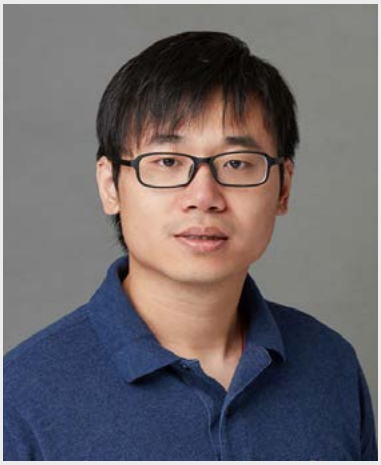
In November 2019, the University of Memphis Research Foundation signed an agreement to license a U.S. patent for an Adaptive Multi-factor Authentication System invented and developed by a team led by **Professor Dipankar Dasgupta**, director of the Center for Information Assurance.

The patent is licensed to i2Chain, a San Francisco-area cybersecurity startup, which plans to evolve adaptive authentication for its own applications as well as offer the technology as a service to other identity providers.

"Digitalization and new privacy laws are forcing companies to enact creative and proven solutions to secure their identity and information," said Ajay Jotwani, co-founder and CEO of i2Chain. "This invention allows us to improve the identity defense as well as build research collaboration with Dr. Dasgupta and the Center for Information Assurance at the UofM."

For more information, see the press release at **memphis.edu/mediaroom/releases/2019/november/cyberpatent.php**





NEW NSF GRANT AND CVPR PAPER

FOR ASSISTANT PROFESSOR XING GAO

Assistant Professor Xing Gao has been awarded a new NSF grant and had a paper accepted to the prestigious CVPR conference. The grant, titled "Securing Containers in Multi-Tenant Environment via Augmenting Linux Control Groups" and funded with $175,000 from the National Science Foundation, will investigate and improve the security of container technology in the Linux operating system.

The paper, "Evade Deep Image Retrieval by Stashing Private Images in the Hash Space," is joint work with Yanru Xiao and Cong Wang from Old Dominion University. It will be presented at CVPR 2020, the premier annual computer vision conference.

DEPARTMENT RECEIVES $10K GRANT FROM NCWIT

The department has been awarded a $10,000 grant from the National Center for Women & Information Technology to help recruit and retain female undergraduate students. The grant funds will go toward three initiatives in 2020:

- Faculty development workshops to encourage active learning in introductory courses
- Student-led problem sessions in introductory courses to provide extra practice
- After-school computer science clubs in area high schools to help with outreach

Professor Vinhthuy Phan, instructor **Kriangsiri Malasri** and project coordinator **Lyndsey Rush** were involved in the grant application.

DATA SCIENCE IN PYTHON WORKSHOPS

Since 2016, the department has held a regular series of workshops on using Python in data science, aimed at professional clients. These workshops are typically offered in sets of two: an introductory session on Python Programming and Data Analytics, and a follow-up advanced session on Data Science and Machine Learning. For upcoming workshop dates and registration, visit **memphis.edu/cs/outreach/ds_workshops.php**.

MEDIA EXPOSURE

The Map901 project was featured on GCN in August 2019 for its potential impact on first responders' safety and efficiency. The project involves the use of light detection and ranging (LiDAR) technology to map building interiors.

Map901 is a collaboration among the City of Memphis, Professor Lan Wang in the Department of Computer Science and professor Eddie Jacobs in the Department of Electrical and Computer Engineering.

For more: **gcn.com/articles/2019/08/07/lidar-indoor-mapping-responders.aspx**

CREATIVE GAME DESIGN CAMP

The Creative Game Design Camp for high school students will be held Monday-Friday, July 13-17. This camp allows students from a variety of backgrounds to work in teams to develop a simple but functional game with an emphasis on storytelling. For more information or to register: **goo.gl/QH8wMW**

FACULTY AND STAFF ACHIEVEMENTS

Professor Dipankar Dasgupta gave an invited talk on his adaptive multi-factor authentication (A-MFA) research at the University of Oxford. A-MFA dynamically selects different authentication modalities in order to make it more difficult for adversaries to exploit the system. He gave the keynote talk at ICSC 2019 at the Jaypee Institute of Information Technology in India and also gave several talks as part of the ACM Distinguished Speakers Program (Sikkim Manipal Institute of Technology, India; ABES Engineering College, India; Lancaster University, UK). In addition, Dasgupta gave several talks around the UofM as part of FedEx Institute of Technology events and the McWherter Library NEDTalks series.

Professor Sajjan Shiva delivered the keynote address "Building Intelligent Systems – Opportunities and Challenges" at the 107th Indian Science Congress (ISC), Bengaluru, India, Jan. 3–7. Inaugurated by Prime Minister Narendra Modi, ISC is the premier Indian science conference and is attended by about 12,000 scientists. Six U.S. scientists (including Shiva) and two Nobel laureates (from Germany and Israel) were invited to participate.

Shiva also gave invited talks on "Artificial Intelligence Today: Rewards and Risks" at the Siddaganga Institute of Technology, India, and "Knowledge Engineering" at the Medical Sciences Institute of Adichunchanagiri University, India, in January.

Professor Lan Wang, department chair, was selected to receive the 2019 Alumni Association Distinguished Research Award in Science, Engineering and Mathematics. She joins **Professors Santosh Kumar**, **Dipankar Dasgupta** and **Stan Franklin** among the Computer Science faculty who have received this prestigious award.

STUDENT NEWS

PhD student **Sajib Sen** (pictured above) presented his paper "Linear Regression Models for Extracellular Fluid Measurement Based on Bioelectrical Impedance Analysis" at the IEEE-EMBS International Conference on Biomedical and Health Informatics (BHI 2019), a flagship conference in bioinformatics.

PhD student **Sayma Akther** presented her paper on the mOral system at ACM UbiComp 2019 in London. She had received awards for this work at the CS Research Day and University Research Forum events earlier in 2019.

PhD student **Soujanya Chatterjee** interned with the Digital Health Lab at Samsung Research America during summer 2018 and 2019. He worked on several mHealth projects, with the overall goal of demonstrating that the smartphone and the smartwatch can be transformed into effective and accessible tools for monitoring chronic health conditions.

One of the projects developed a computational model (coined mWheeze) that can detect abnormal lung sounds and irregular breathing patterns via a smartphone when it is placed on the user's chest. Using mWheeze, Soujanya and his team explored the feasibility of assessing the severity of pulmonary obstruction in patients suffering from chronic obstructive pulmonary disease (COPD) and asthma. This work resulted in an ACM CHI 2020 paper and one patent.

Students from **Professor Dipankar Dasgupta**'s Center for Information Assurance published several papers in conferences and journals throughout 2019, including:

- Zahid Akhtar and Dipankar Dasgupta, "A Comparative Evaluation of Local Feature Descriptors for DeepFakes Detection," IEEE Symposium on Technologies for Homeland Security (HST), pp. 1-5, Woburn, USA, Nov. 5-6, 2019.
- Debanjan Sadhya, Zahid Akhtar and Dipankar Dasgupta, "A Locality Sensitive Hashing Based Approach for Generating Cancelable Fingerprints Templates", IEEE International Conference on Biometrics: Theory, Applications and Systems (BTAS), pp. 1-8, Tampa, Florida, Sep. 23-26, 2019.
- Herbadji Abderrahmane, Guermat Noubeil, Ziet Lahcene, Zahid Akhtar, Dipankar Dasgupta, "Weighted Quasi-Arithmetic Mean Based Score Level Fusion for Multibiometric Systems," IET Biometrics, pp. 1-13, 2019.
- Subash Poudyal, Dipankar Dasgupta, Zahid Akhtar, Kishor Datta Gupta, "A Multi-Level Ransomware Detection Framework using Natural Language Processing and Machine Learning," IEEE International Conference on Malicious and Unwanted Software (MALCON), pp. 1-8, Nantucket, USA, Oct. 1-4, 2019.
- Joao Monteiro, Isabela Albuquerque, Zahid Akhtar, Tiago H. Falk, "Generalizable Adversarial Examples Detection Based on Bi-Model Decision Mismatch," IEEE International Conference on Systems, Man and Cybernetics (SMC), pp. 1-6, Bari, Italy, Oct. 6-9, 2019.
- Subash Poudyal, Zahid Akhtar, Dipankar Dasgupta, Kishor Datta Gupta, "Malware Analytics: Data Mining, Machine Learning and Big Data Perspectives," IEEE Symposium Series on Computational Intelligence (SSCI), pp. 1-7, Xiamen, China, Dec. 6-9, 2019.
- Shiba Kuanar, Vassilis Athitsos, Dwarikanath Mahapatra, K. R. Rao, Zahid Akhtar, Dipankar Dasgupta, "Low Dose Abdominal CT Image Reconstruction: An Unsupervised Learning Based Approach," IEEE International Conference on Image Processing (ICIP), pp. 1351-1355, Taipei, Taiwan, Sep. 22-25, 2019.
- D Dasgupta, JM Shrein, KD Gupta, "A survey of blockchain from security perspective," Journal of Banking and Financial Technology 3 (1), 1-17.
- A Khan, KD Gupta, A Haque, "Resolution Enhancement of Electron Microscopic Volume by Volume Restoration Technique," SAI, NCO, SOFT, ICAITA, CDKP, CMC, SIGNAL – 2019.
- S Poudyal, D Dasgupta, Z Akhtar, K Gupta, "A multi-level ransomware detection framework using natural language processing and machine learning," 14th International Conference on Malicious and Unwanted Software (MALCON).
- S Poudyal, Z Akhtar, D Dasgupta, KD Gupta, "Malware Analytics: Review of Data Mining, Machine Learning and Big Data Perspectives," IEEE Symposium Series on Computational Intelligence (SSCI).
- S Poudyal, KD Gupta, S Sen, "PEFile Analysis: A Static Approach to Ransomware Analysis," International Journal of Forensic Computer Science 14.

STUDENT NEWS (CONTINUED)

Students from **Professor Sajjan Shiva's** Game Theory in Cybersecurity lab have made numerous recent publications, including:

1. Abuhussein, Abdullah, Faisal Alsubaei, and Sajjan Shiva. "Toward an Effective Requirement Engineering Approach for Cloud Applications." Book chapter in "Software Engineering in the Era of Cloud Computing," Springer, January 2020.

2. Mahfouz, Ahmed M., Deepak Venugopal, and Sajjan G. Shiva. "Comparative Analysis of ML Classifiers for Network Intrusion Detection." In *Fourth International Congress on Information and Communication Technology*, pp. 193-207. Springer, Singapore, 2020.

3. Das, Saikat, Ahmed M. Mahfouz and Sajjan Shiva. " A Holistic Approach for Detecting DDoS Attacks by Using Ensemble Unsupervised Machine Learning." Proceedings of the Future of Information and Communication Conference (FICC), San Francisco, 2020.

4. Alsubaei, Faisal, Abdullah Abuhussein, Vivek Shandilya and Sajjan Shiva. "IoMT-SAF: Internet of medical things security assessment framework." Internet of Things 8 (2019): 100123.

5. Putta, Swapnika Reddy, Abdullah Abuhussein, Faisal Alsubaei, Sajjan Shiva and Saleh Atiewi. "Security Benchmarks for Wearable Medical Things: Stakeholders-Centric Approach." ICICT 2019: Fourth International Congress on Information and Communication Technology, London, UK, 2019.

6. Das, Saikat, Ahmed M. Mahfouz and Sajjan Shiva. "A Stealth Migration Approach to Moving Target Defense in Cloud Computing." In Proceedings of the Future Technologies Conference, pp. 394-410. Springer, Cham, 2019.

7. Das, Saikat, Ahmed M. Mahfouz, Deepak Venugopal and Sajjan Shiva. "DDoS Intrusion Detection Through Machine Learning Ensemble." In 2019 IEEE 19th International Conference on Software Quality, Reliability and Security Companion (QRS-C), pp. 471-477. IEEE, 2019.

8. Alsubaei, Faisal, Abdullah Abuhussein and Sajjan Shiva. "Ontology-Based Security Recommendation for the Internet of Medical Things." IEEE Access 7 (2019): 48948-48960.

Undergraduates Compete in 2019 CCSC Mid-South Programming Contest

Five undergraduate students participated in the 2019 CCSC (Consortium for Computing Sciences in Colleges) Mid-South Programming Contest held on April 12 at the University of Arkansas at Little Rock.

Pictured above left to right: **Albert Nguyen** and **Avery Clary** (team name: Bad Zealots) and **Marshal Hayes**, **Ryan Wickman** and **Michael Bowman** (team name: LossNotFoundException) faced stiff competition from the other 13 teams in the contest. LossNotFoundException held the lead for a portion of the contest but ultimately finished in a respectable sixth place. The full results are available at **ccsc19.kattis.com/standings**.

STUDENT SPOTLIGHT Ryan Wickman

Ryan Wickman is a senior in the undergraduate computer science program, where he has maintained excellent grades in addition to being involved in various internship and extracurricular activities.

He has served as the leader of the True Bit Union Association (TBUA), a student group focused on game development. During his tenure, the group developed a horror game that procedurally generates a new maze each time the game is played. Currently, Ryan is the vice president of the department's ACM student chapter, whose first website he built as a freshman.

Ryan was an intern at AutoZone from May-December 2017, where he worked in front-end development creating landing pages for AutoZone pro clients and fixing various bugs on their website. He also worked as an undergraduate research assistant in the UofM's Networking Research Lab from April 2018-April 2019 on the Named Data Networking (NDN) project, which aims to develop a new internet architecture. He performed a variety of tasks, including implementing a layer of security to an existing networking application, creating scripts to parse different forms of output/logs, and even assisting with a classified project for DARPA.

Ryan was hired by Google as a summer 2019 intern at their Bellevue campus, where he worked on People and Sharing Engineering Productivity tools and implementing a new structure for logging anomalies in their People and Sharing stack. He is currently in the UofM's accelerated BS/MS program. Once he completes his degree, Ryan would like to work in the field of machine learning, become a software engineer or potentially continue to obtain a PhD to work as a research scientist.

2019 GRADUATES

PhD
Pulin Agrawal
(Advisor: Dr. Vasile Rus)
Eiman Aldhahri
(Advisor: Dr. Sajjan Shiva)
Dipesh Gautam
(Advisor: Dr. Vasile Rus)
Nabin Maharjan
(Advisor: Dr. Vasile Rus)

MS
Keli Cheng
(Advisor: Dr. Deepak Venugopal)
Muktadir Chowdhury
(Advisor: Dr. Lan Wang)
Zannatul Firdous
(Advisor: Dr. Deepak Venugopal)
Bryant Ford
(Advisor: Dr. Max Garzon)
Ashlesh Gawande
(Advisor: Dr. Lan Wang)
Aashis Ghimire
(Advisor: Dr. Thomas Watson)
Steve Lee
(Advisor: Dr. Scott Fleming)
Liangqun Lu
(Advisor: Dr. Scott Fleming)
Ayushi Mehta
(Advisor: Dr. Dipankar Dasgupta)
Alejandro Gil Torres
(Advisor: Dr. Scott Fleming)
Venkata Yanamandram
(Advisor: Dr. Bill Baggett)

BS
Omar Alghamdi
Adnan Ali
K. Val Ault
Michael Bowman
L. Rex Browning
Jackson Burnett
Ellen Chapman
Samuel Charney
Michael Ciskowski
Noah Coomer
Ruben Cuervo Morales
Mark Delk
Allen Dorris
Brandon Ellis
W. Logan Fancher
Xia Fang
Charles Floyd
Anuja Gawande
Thomas Goodman
Hudson Gribble
Noah Hanks
Glenn Harper
Marshal Hayes
C. Shawn Hickman
Matthew Hume
Jacob Hunt
Wesley Jones
Caleb Kelsey
Austin King
Dung Le
Jacques-Gaius Lemassi
Aaron Leonard
Zijie Liu
Armando Magana
Nathan Martin
Rylan McCarty
Stephen Moo-Young
James Myers
Quoc Nguyen
R. Chris Odum
Brian Peterson
Thi Phan
David Reddick
Joshua Rhoades
Adam Rogers
Zackery Salerno
Casey Satran
Obsa Siyo
Kaveon Smith
Taylun Smith
Duc Ta
Davin Thomas
Xavier Tilley
Derico Walker
Jamie Walker
Peyton Warren
Yucheng Zhang

2019 INTERNSHIPS

Robb Aquadro (BS)
- Green Mountain Technology

Malcolm Bryant (BS)
- MLGW

Jackson Burnett (BS)
- UMRF Ventures, Inc.

Soujanya Chatterjee (PhD)
- Samsung Research America, Inc.

Kristin Davis (BS)
- Shelby County Schools

Mark Delk (BS)
- SandStorm IT, Inc.

Henry Fyfe (BS)
- Green Mountain Technology

Ashok Gadde (MS)
- Conch Technologies, Inc.

Michael Hollister (MS)
- CrossBrowserTesting

Mykaila Johnson (BS)
- UMRF Ventures, Inc.

Rashaad Jones (BS)
- Monogram Foods

Anik Khan (PhD)
- ReTrans

Dung Le (BS)
- International Paper

Adam Losher (BS)
- UMRF Ventures, Inc.

Nathan Martin (BS)
- ManTech

Ryan McKinstry (BS)
- COMP Performance Group

Varun Negandhi (BS)
- FedEx Services

Stephen Rogers (BS)
- UMRF Ventures, Inc.

Nazir Saleheen (PhD)
– Samsung Research America, Inc.

Pradeep Sambu (MS)
- UMRF Ventures, Inc.

Sajib Sen (MS)
- ReTrans

Gabriel Short (BS)
- UMRF Ventures, Inc.

Utsav Shrestha (MS)
- UMRF Ventures, Inc.

Neha Sinha (MS)
- FedEx Services

Jada Thomas (BS)
- International Paper

Benjamin Young (BS)
- Naval Air Warfare Center Training Systems Division

SUPPORTING
THE DEPARTMENT

The Department has been fortunate to receive several generous gifts from donors. Gifts can endow professorships, scholarships, fellowships, classrooms and labs for our students. They can also be used to help defray travel expenses for conferences to present research papers, as well as many other activities that are extremely meaningful to our students and the Memphis community.

If you are interested in making a tax-deductible donation, visit the University of Memphis Giving site at **http://bit.ly/2wFQwim**. Select "All CAS Funds" at the top, then "Computer Science Discretionary Fund" (for general support) or "Diversity in Computer Science Scholarship" (to support that specific award).

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