NSA/DHS
National Centers of Academic Excellence in Cyber Defense Education
2019 Annual Report

Name of Institution
University of Memphis

Program(s) of Study (add rows if necessary) and Department
Computer Science Department **Programs:** B.S Cyber Security Concentration • Graduate Certificate in Cyber Security and Information Assurance • Ph.D in computer science with research and dissertation in cyber security **Business Information and Technology Department** **Programs:** Graduate Certificate Program in Business Information Assurance • Graduate Certificate Program in Software Testing • Ph.D in BIT with research and dissertation in business information security

Submitters Name	Contact Information
Dr. Dipankar Dasgupta	ddasgupt@memphis.edu

NOTE: Every year, NSA/DHS Centers of Academic Excellence in Cyber Defense Education and Research must submit an annual report containing information regarding student enrollment, number of graduates, student placement, research funding, and a variety of other variables. Submitting this information is a requirement for re-designation.

Please submit your information no later than February 15, 2020. If you have questions regarding the CAE Program or the annual report itself,

please feel free to contact the CAE Program Office at AskCAEIAE@nsa.gov.

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I.   Contact Information (since last designation)

   a.   Provide name and contact information of new faculty teaching in the Program of Study
   b.   Provide name and contact information for the two levels above Program of Study POC

New Faculty	Faculty Contact Information
Dr. Jim Andrew McGinnis	jmcgnnis@memphis.edu

Leadership Information (Department Chair, Dean, etc)	Contact Information
Dr. Lan Wang-Department Chair	lanwang@memphis.edu

II.   Student Enrollment

Identify the number of students currently enrolled in the programs reflective of the CAE designation for the last academic year – identify any that apply.

Number of students enrolled			
AA		MS	34
BA		MBA	
BS	33	PhD	60
MA		Other (Graduate Certificate Program in Business Information Assurance)	20

III.   Graduates

Identify the number of students that have graduated from the programs reflective of the CAE designation for the last academic year – identify any that apply.

Number of graduates			
AA		MS	
BA		MBA	
BS		PhD	4
MA		Transfers	
GC Graduate	1	Graduate Certificate	2

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Certificate (Cyber Security Information Assurance)		(Business Information Assurance)	

IV.   Student Placement

−   Identify where students graduating from the programs reflective of the CAE designation have placed after graduating. This metric should be categorized by the number of students placed into government, industry and academic positions for the last academic year.

NSA	Gov	Industry	Academia	Advanced Degree	Other	Don't collect data
						X

V.   Student Development Opportunities

–   "Student development opportunities" that are available to students in your program

First column check yes if offered, second column indicate numbers of students that took advantage of the opportunity		
X	2	Internships
		Apprenticeships
X	5	Co-operative education experiences (e.g., technical directors, students & faculty work together)
		Other (please specify)

VI.   Curriculum Changes

-   Has your curriculum changed since your institution's last designation application or annual report?

Identify Courses that have been removed from the original KU mapping
Security & Privacy in Cloud - COMP 7998

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Identify any NEW Courses that have been added or modified in the Program of Study Path – provide a short description
Secure Coding and Testing - COMP 4432
Network and Mobile Security - COMP 4420

VII. NICE Framework Crosswalk

- Identify how the mapped Program of Study path relates to the NICE Cybersecurity Workforce Framework (NCWF), NIST SP 800-181 category(s). Check all that apply:

	NICE Framework Categories
X	Operate and Maintain
	Oversee and Govern
X	Protect and Defend
X	Investigate
	Collect and Operate
X	Analyze
	Securely Provision

VIII. Research Funding (applies to Bachelors, Masters, Doctoral programs)
Associate Programs skip to IX. Since the institution's last designation application:

- Identify any significant funding for CD research relevant to the current core areas/sub area of expertise (see core area list): Principles; Security Mechanisms/Functionality; Architectures; Assurance; Operations; Analysis; Non-Technical IA Issues; or Other non-identified areas.

Date	Source	Amt	Brief Description
10/1/14-3/31/19	Norwich University, DHS/FEMA/DHS/FEMA II	$331,000	Cyber Security Competitive Training Grant
9/1/17-9/13/19	NSA	$206,085	CAE Cyber Security Workforce Development: This grant will be used to develop interactive, hands-on exercises to integrate in cybersecurity curriculum. **Announcement** 1:http://www.memphis.edu/mediaroom/releases/2017/sept17/cybersecurity.php

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			Announcement 2: http://www.memphis.edu/cs/news_and_events/news/2017_cfia_cyber_sec_curriculum.php)
1/15/16-9/30/19	Lead: UALR Prime: DHS/FEMA III	$473, 218	Mobile Device Security and Privacy University of Arkansas Little Rock collaboration
7/1/18-12/31/19	FIT	$15,000	CAST: PKChain: Decentralized Public-Key Management System Based on Blockchain Technology
9/2017-8/30/20	FEMA/DHS	$400,000	Preparing for Next Generation Cyber Defense
9/1/17 - 8/31/20	Lead: NU Prime: DHS/FEMA	(Multi-University Grant of 2.2 million)	Realizing Advanced Persistent Threats Norwich University Applied Research Institute

IX. Institution Successes & Achievements

Since the institution's last designation application:

– Describe activities that represent successes and achievements of the program(s) reflective of the CAE designation such as scholarships, outreach, partnerships, awards, conference participation, etc.

Success/Achievements
On November 25th, 2019 - The University of Memphis Research Foundation (UMRF) has signed an agreement to license a U.S. patent with i2Chain, a San Francisco area cybersecurity startup, for an Adaptive Multi-factor Authentication (A-MFA) System invented and developed by a team led by Dr. Dipankar Dasgupta. This news was also featured at Daily Memphian. The August,2019 issue of FedTech magazine (which is widely circulated among federal agencies) interviewed Dr. Dasgupta as an expert in the field and mentioned in an article (on 7th paragraph) for DOD's use of latest Technologies and implementation of CMFA (Continuous Multi-Factor Authentication). Dr. Dasgupta will organize symposium on **Computational Intelligence in Cyber Security (CICS) at the IEEE Symposium Series on Computational Intelligence (SSCI)** in Xiamen, China from Dec 6 - 9, 2019. Click here for more details. Dr. Dasgupta gave an invited talks on Online Social Networks and Privacy Issues and engaged in discussion on research collaboration, curriculum, student visits, etc. at Lancaster University (https://www.lancaster.ac.uk/events/acm-distinguished-talk-on-online-social-networks-and-privacy-issues) on June 11,2019. Dr. Dasgupta gave an invited talk on their patented research (A-MFA) at Oxford University (http://www.cs.ox.ac.uk/seminars/2225.html) on June 7,2019.

Dr. Dasgupta gave an invited talks on Cyber Security to establish a cross university Institute for Cyber Security research at City University of London on June 5,2019.

Dr. Dasgupta gave CAST Training on Cyber security at FedEx Institute of Technology on May 2, 2019.

Dr. Dasgupta gave a talk on "data privacy in research" at Research & Networking Breakfast Series at FedEx Institute of Technology, April 24, 2019

Dr. Dasgupta gave NEDTalk on "Hashtag & emoji in social media" at University of Memphis McWherter Library on April 18, 2019.

Dr. Dasgupta gave Keynote ICSC-2019 at Jaypee Institute of Information Technology, Noida (INDIA) on March 9, 2019.

Dr. Dasgupta gave ACM Distinguish Speaker Program (DSP) lecture on "Genetic and Evolutionary Computation in Defense, Security and Risk Management" at ABES Engineering College, March 8, 2019, Ghaziabad, India.

Dr. Dasgupta gave ACM-DSP Keynote Speech on Puzzle-based learning in Cyber Security Education at Second International Conference on Advanced Computational and Communication Paradigms (ICACCP 2019) (http://www.icaccpa.in/) at Sikkim Manipal Institute of Technology (SMIT), February 25 - 28, 2019, Sikkim, India

Weighted Quasi-Arithmetic Mean based Score Level Fusion for Multibiometric Systems

Z Akhtar, A Herbadji, G Noubeil, Z Lahcene, D Dasgupta

IET Biometrics

Multi-user permission strategy to access sensitive information

D Dasgupta, A Roy, D Ghosh

US Patent App. 15/949,111 (2020)

A Multi-Level Ransomware Detection Framework using Natural Language Processing and Machine Learning

S Poudyal, D Dasgupta, Z Akhtar, K DattaGupta

International Conference on Malicious and Unwanted Software (MALCON), Boston …2(2019)

Low Dose Abdominal CT Image Reconstruction: An Unsupervised Learning Based Approach

S Kuanar, V Athitsos, D Mahapatra, KR Rao, Z Akhtar, D Dasgupta

2019 IEEE International Conference on Image Processing (ICIP), 1351-1355 (2019)

Multi-user permission strategy to access sensitive information

D Dasgupta, A Roy, D Ghosh

US Patent App. 15/932,439(2019)

Face Authenticity: An Overview of Face Manipulation Generation, Detection and Recognition

Z Akhtar, D Dasgupta, B Be\anerjee

International Conference on Communication and Information Processing (ICCIP …

6(2019)

AI vs. AI: Viewpoints

D Dasgupta

Technical Report (No. CS-19-001), The University of Memphis (2019)

A survey of blockchain from security perspective

D Dasgupta, JM Shrein, KD Gupta

Journal of Banking and Financial Technology 3 (1), 1-17 12(2019)

Design and implementation of Negative Authentication System

D Dasgupta, AK Nag, D Ferebee, SK Saha, KP Subedi, A Roy, A Madero, ...

International Journal of Information Security 18 (1), 23-48 (2019)

A brief survey of Adversarial Machine Learning and Defense Strategies

Z Akhtar, D Dasgupta (2019)

In 2019, Dr. McGinnis became the Co-Director of the Center for Information Assurance (CfIA) -In collaboration with

the Computer Science Department Member of National Cybersecurity Preparedness Consortium (NCPC).
2019 ESCS'19 - The 17th Int'l Conference on Embedded Systems, Cyber-physical Systems, and Applications
Presentation and Publication "Healthcare Cybersecurity Issues: Framework for Healthcare" ISBN: 1-60132-496-0, CSREA Press ©
 2018 IoT Security Summit Dallas
Presentation "IOT Security Methodology"
 2018 International Conference Embedded Systems, Cyber-Physical Systems, ESCS'18
Presentation and Publication "Hardening Your Network Before the Next Attack", ISBN: 1-60132-475-8, CSREA Press © Dr. McGinnis also served as Director of NetAcad (Cisco Networking Academy) and as a member of National Cybersecurity Preparedness Consortium (NCPC).
Dr. Xing Gao accomplished the following in Cyber Defense Research in 2019: Xing Gao, Zhongshu Gu, Zhengfa Li, Hani Jamjoom, Cong Wang,
"**Houdini's Escape: Breaking the Resource Rein of Linux Control Groups**",
to appear in *ACM CCS 2019*, London, UK, November 2019.
Cong Wang, Yanru Xiao, **Xing Gao**, Li Li, Jun Wang,
"**Close the Gap between Deep Learning and Mobile Intelligence by Incorporating Training in the Loop**",
in *ACM Multimedia 2019*, Nice, France, October 2019. (**Oral presentation: 9.9%**)

Dr. Won served as guest editor for MDPI Electronics (Impact Factor 1.764)
TPC:
The IEEE International Conference on Mobile Ad-Hoc and Smart Systems (MASS)
The IEEE Wireless Communications and Networking Conference (WCNC)
The International Conference on Wireless and Mobile Computing, Networking and Communications (Wimob)
The Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies (IMWUT)
Proposal Review : National Science Foundation (NSF) Review Panel.
 Papers:
M. Won, S. Sahu, and K. Park, "**DeepWiTraffic: Low Cost WiFi-Based Traffic Monitoring System Using Deep Learning**", International Conference on Mobile Ad-Hoc and Smart Systems (MASS), 2019.
M. Won, W. Zhang, C. Chen, and R. Stoleru, "**GROLL: Georgraphic Routing for Low Power and Lossy IoT Networks**", Elsevier Internet of Things Journal, 2019.

Dr. Zahid Akthar
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.

Yifan Li, Yuchun Fang, Zahid Akhtar, "**Accelerating Deep Reinforcement Learning Model for Game Strategy**", Neurocomputing, Special Issue on Deep Neural Information Processing, Elsevier, pp. 1-28, 2019.

Rajesh Shrivastava, Chittaranjan Hota, Govind Mittal, Zahid Akhtar, "**UnderTracker: Binary Hardening Through Execution Flow Verification**", International Conference on Secure Knowledge Management in Artificial Intelligence Era (SKM), pp. 1-20, Goa, India, December 21-22, 2019.

Multitrait Selfie: Low Cost Multimodal Smartphone User Authentication
Z Akhtar, A Buriro
Biometric Identification Technologies Based on Modern Data Mining Methods 2020

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A deep learning platooning-based video information-sharing Internet of Things framework for autonomous driving systems Z Zhou, Z Akhtar, KL Man, K Siddique
International Journal of Distributed Sensor Networks 15 (11), 1550147719883133, 2019

Why is multimedia quality of experience assessment a challenging problem?
Z Akhtar, K Siddique, A Rattani, SL Lutfi, TH Falk
IEEE Access 7, 117897-117915, 2019

KDD Cup 99 Data Sets: A Perspective on the Role of Data Sets in Network Intrusion Detection Research
K Siddique, Z Akhtar, FA Khan, Y Kim Computer 52 (2), 41-51, 2019.
3D palmprint recognition using unsupervised convolutional deep learning network and SVM Classifier
C Mourad, Z Akhtar, A Attia
IET Image Processing, 1-12, 2019.

A brief survey of Adversarial Machine Learning and Defense Strategies
Z Akhtar, D Dasgupta, 2019.

Malware Analytics: Review of Data Mining, Machine Learning and Big Data Perspectives
S Poudyal, Z Akhtar, D Dasgupta, KD Gupta
IEEE Symposium Series on Computational Intelligence (SSCI), 2019.

A Locality Sensitive Hashing Based Approach for Generating Cancelable Fingerprints Templates
D Sadhya, Z Akhtar, D Dasgupta
IEEE International Conference on Biometrics: Theory, Applications and …, 2019.

A multi-level ransomware detection framework using natural language processing and machine learning
S Poudyal, D Dasgupta, Z Akhtar, K Gupta
14th International Conference on Malicious and Unwanted Software" MALCON
2, 2019.

Face Authenticity: An Overview of Face Manipulation Generation, Detection and Recognition
Z Akhtar, D Dasgupta, B Banerjee
International Conference on Communication and Information Processing (ICCIP …
2019

A Comparative Evaluation of Local Feature Descriptors for DeepFakes Detection
Z Akhtar, D Dasgupta
IEEE Symposium on Technologies for Homeland Security (HST), 1-5, 2019.

Free-Reference Image Quality Assessment Framework using Metrics Fusion and Dimensionality Reduction
B Sadou, A Lahoulou, T Bouden, AR Avila, TH Falk, Z Akhtar
Signal & Image Processing: An International Journal (SIPIJ) 10 (5), 1-14, 2019.

Human Behavior Understanding in Big Multimedia Data Using CNN based Facial Expression Recognition
M Sajjad, S Zahir, A Ullah, Z Akhtar, K Muhammad
Mobile Networks and Applications, 1-11, 2019.

Blind Image Quality Assessment Using Singular Value Decomposition Based Dominant Eigenvectors For Feature Selection
B Sadou, A Lahoulou, T Bouden, AR Avila, TH Falk, Z Akhtar
5th International Conference on Signal and Image Processing (SIPRO), 233-242, 2019.

Low Dose Abdominal CT Image Reconstruction: An Unsupervised Learning Based Approach
S Kuanar, V Athitsos, D Mahapatra, KR Rao, Z Akhtar, D Dasgupta
IEEE International Conference on Image Processing (ICIP), 2019.

Vision Based Computing Systems for Healthcare Applications
S Murala, SK Vipparthi, Z Akhtar
Journal of healthcare engineering 2019
Dr. Zahid Akhtar elevated to the grade of IEEE Senior Member in 2019; IEEE Senior Membership grade is held by only 8% of IEEE's approximately 428,000 members.
Dr. Zahid Akhtar received a College of Arts & Sciences Travel Enrichment award for Summer 2019, University of Memphis, USA.
Dr. Zahid Akhtar received Best Reviewer Award at International Conference on Vision, Image and Signal Processing (ICVISP) – 2017 (Japan), 2018 (USA) and 2019 (Canada).
Dr. Zahid Akhtar was a member of Technical Program Committee
International Conference on Big Data Analytics, Data Mining and Computational Intelligence (BIGDACI) – 2019.
International Conference on Robot Systems and Applications (ICRSA) – 2019.
International Conference on Vision, Image and Signal Processing (ICVISP) – 2019.
International Conference on Biomedical Signal and Image Processing (ICBIP) – 2019.
Dr. Zahid Akhtar served in 2019 as a reviewer for: **International Journals**
IEEE Internet of Things Journal (ITJ) (Impact Factor = 9.515)
IEEE Transactions on Industrial Informatics (TII) (Impact Factor = 7.377)
IEEE Transactions on Information Forensics and Security (TIFS) (Impact Factor = 4.332)
IEEE Transactions on Multimedia (TMM) (Impact Factor = 5.452)
IEEE Multimedia Magazine (Impact Factor = 3.556)
IEEE Access (Impact Factor = 4.098)
International Conferences
IEEE International Conference on Identity, Security and Behavior Analysis (ISBA) – 2019
1st Workshop on Computer Vision for Global Challenges @ CVPR – 2019
International Conference on Vision, Image and Signal Processing (ICVISP) – 2019

 Dr. Kan Yang
Publications:
1.   G. Xu, H. Li, H. Ren, **K. Yang** and R. H. Deng, "Data Security Issues in Deep Learning: Attacks, Countermeasures, and Opportunities". IEEE Communication Magazine, vol. 57, no. 11, Nov 2019.
2.   G. Xu, H. Li, S. Liu, **K. Yang** and X. Lin, "VerifyNet: Secure and Verifiable Federated Learning," IEEE Transactions on Information Forensics and Security, vol. 15, pp. 911-926, July, 2019.
3.   G. Xu, H. Li, Y. Dai, **K. Yang** and X. Lin, "Enabling Efficient and Geometric Range Query with Access Control Over Encrypted Spatial Data," in IEEE Transactions on Information Forensics and Security, vol. 14, no. 4, pp. 870-885, April 2019.
 Technical Program Committee

IEEE International Conference on Blockchain (Blockchain 2019).
IEEE International Conference on Mobile Ad hoc and Sensor Systems (IEEE MASS'19:Security and Privacy Track)
IEEE Global Communications Conference (GLOBECOM'19)
IEEE International Conference on Communications (ICC'19-CISS)

X.   Designation Return on Investment

– Identify any opportunities, successes and/or achievements specifically resulting from the institution's designation as a CAE.

Return on Investment
The Center for Information Assurance's (CfIA) CAE designation has opened opportunities for the center to act as a HUB for educational institutions, government agencies, and local businesses on Cybersecurity initiatives. We have had the opportunity to work with other universities that have received the CAE-CD and/or CAE-CD & CAE-R designation as a founding member of the National Cybersecurity Preparedness Consortium (NCPC) on research that has produced cutting edge research and created multiple training opportunities. The University of Memphis is proud to announce that formal agreements have been made with the following schools for shared curriculums, lectures, and teaching materials. We hope that this is the first step of many towards significantly greater exposure and recognition for the Information Technology capabilities of the participating schools and surrounding businesses. We hope that continued interest will be maintained by the Mid-South area and our efforts can encourage the growth of not only the students but also the private sector as a result of a supply of NSA certified graduates entering the job market.

Silicon Valley Startup Licenses Patent for Adaptive Multi-Factor Authentication System
The University of Memphis Research Foundation has signed an agreement to license a U.S. patent for an Adaptive Multi-factor Authentication System invented and developed by a team led by Dr. Dipankar Dasgupta, professor of Computer Science and 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.
Professor Dasgupta Visits UK Universities
Prof. Dipankar Dasgupta gave an invited talk on his adaptive multi-factor authentication (A-MFA) research at the University of Oxford on a recent visit to the UK. A-MFA dynamically selects different authentication modalities in order to make it more difficult for adversaries to exploit the system.
Prof. Dasgupta also gave a talk about online social networks and privacy issues at Lancaster University as part of the ACM Distinguished Speakers program.
Cyber Workforce Education (virtual reality)

A series of professional development workshops that focus on Cybersecurity, Secure Coding, and More. We developed a virtual forensic game to get hands-on experience solving crime situations. We also submitted an article to an open source publication.

Online Cybersecurity Courses

Online courses that focus on various aspects of Cybersecurity. These FEMA funded courses are free for all users. Our most recent course "Secure Coding and Testing" will be available soon.

Cybersecurity Radio Show

Cybersecurity Radio Show 1 https://www.memphis.edu/cfia/medias/cyber-security-1-2018-mixdown.mp3
Cybersecurity Radio Show 2 https://www.memphis.edu/cfia/medias/cyber-security-2-2018-mixdown.mp3

We have successfully collaborated with high schools and youth organizations to assist them in implementing cybersecurity curriculum into their current program of study. The Center has continued communications with TigerLIFE (A program at the University of Memphis that provides individualized courses of study to adults with special needs and increases chances of gainful employment) and Manassas High School to create initiatives that would educate more adults and children with special needs about Cyber Security and Computer Science. A Cybersecurity Merit Badge series for the Boys Scouts of America Chickasaw Council is also in the process of being developed. The Center is working closely with the Boys Scouts of America Chickasaw Council on this initiative.

Currently Engaged Schools

Christian Brothers University
Mid-South Community College
LeMoyne-Owen College
Rhodes College
Rust College

In an effort to expand the influence of the program we are trying to involve as many schools as possible. Each school in the program has the potential to collaborate with the University of Memphis in future proposals and grants. In addition, the University of Memphis will share teaching materials with partners, offer video-lectures, investigate articulation, and promote the continuation of undergraduate and graduate students to pursue a B.S., M.S., or Ph.D. degree with available scholarships in IA. LeMoyne-Owen College, one of the nation's historically black four-year institutions, has applied for their CAE designation and has entered a mentoring relationship with us. We continue to work collaboratively with their Director of Cyber Defense to provide them guidance through this process.

11TH ANNUAL MID-SOUTH CYBERSECURITY SUMMIT

The Center for Information Assurance hosted the 11th Annual Mid-South Cybersecurity Summit at the FedEx Institute of Technology on Oct. 5. This annual summit aims to provide a platform for companies and institutions in the Mid-South region to learn, discuss and exchange information and technologies about cybersecurity. Guest speakers at this year's event included representatives from the City of Memphis, Boeing, XLNTEC, Methodist LeBonheur Healthcare and FedEx. More information is available at

Cyber Ambassadors Tech Camp 2019

The University of Memphis hosted the 2019 Cyber Ambassadors Tech Camp for high school students. This camp introduced students to the concepts of Ethical Hacking, Software Patching and Coding.
The week concluded with a short Capture the Flag competition. By the end of the week, students gained enough experience to earn their own Cyber Ambassador emblems. Additionally, we were able to share our undergraduate and graduate programs to both students and their parents whom expressed interested in receiving more training on Cybersecurity.

Scholarship

Since our designation as a CAE, we have been awarded several internal grants from the University of Memphis and

external grants from government agencies for both research and education. Students have expressed a desire to participate with our institution due to the cutting-edge research that we have been able to study thanks to these grants, and have ultimately allowed us to offer scholarship opportunities to both undergraduate students and graduate students. https://www.memphis.edu/cfia/scholarships/index.php

Hosted the NCPC annual meeting

We have had the opportunity to work with other universities that have received the CAE-CD and/or CAE-CD & CAE-R designation as a founding member of the National Cybersecurity Preparedness Consortium (NCPC) on research that has produced cutting edge research and created multiple training opportunities. This year we had the opportunity to host the National Cybersecurity Preparedness Consortium's annual meeting.

ROTC

The CAE designation has given us the opportunity to develop a proposal for ROTC Research in conjunction with U of M ROTC, Arkansas State University and Arkansas State University ROTC. This will allow us to create additional opportunities to students.

NedTalks

The University of Memphis hosted a two-day research forum designed to share recent research in short presentations completed in the TEDtalks style. Dr. Dasgupta from the Computer Science Department held a presentation entitled "#What the hashtag?!: Social Media in Today's World.

XI. CAE Community Contributions

- Check all that apply to the institution's specific contributions to the CAE Community such as attendance at CAE Community Meetings, participation in working groups, Tech Talk contributor, participation in KU development and refinement, etc.

Community Contributions	
X	Attendance at CAE Community Meetings
X	Participation in CAE Working Groups
X	CAE Research Collaborations
X	Assistance to other institutions seeking CAE designation (e.g.; reviewers, advisors, mentors)
	Tech Talk/CAE Forum speaker
	CAE Regional Resource Center (CCRC) or CAE National Resource Center (CNRC)
	KU Development/Refinement
	Other (Please specify)

XII. Additional Information

- Institution may use this section to provide any additional information not previously mentioned in this report pertinent to the CAE program.

Additional Info

NSA/DHS National Centers of Academic Excellence in Cyber Defense Education

Our Center's students have experienced a lot of success over the course of the past year. While working with our Center, students have completed internships, placements and other co-operative experiences to further facilitate student development opportunities. While working with the Center, these students have received both academic and moral support from our faculty and staff. Student, Ayushi Mehta, I graduated in Spring 2019 (May) and started working at International Paper from September 2019 as IT Business Specialist in SAP FI team. Previously, Ayushi completed an internship at Intel Corporation in Fall 2018. Another student, Sajib Sen also completed two internships in Fall 2019. His roles included writing regression tests and implementing new functional modules that enhance codebase infrastructure for different clients and the company. Additionally, Sajib worked monitoring systems, trends and creating Knowledge Articles with in-depth explanations of various security data sources. One new course "Secure Coding and Testing" will be added to the 2020 Spring semester with the help of the Center's faculty and students. Before launching, Dr. Dasgupta tested and prepared the course materials with his graduate students and researcher, Dr. Andrew Neel. The Center for Information Assurance also welcomed new staff member Dr. James Andrew McGinnis, Jr. to the faculty. Dr. McGinnis brings the expertise of engineering technology in support of our programs and the Center for Information Assurance.

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*Core Area List

1. Principles
- Domains and domain separation
- Resources and resource isolation
- Privileges and least privilege
- Layering
- Application of principles to function, component and system levels
- Composition

2. Security Mechanisms / Functionality
- Cryptography
- Identification and Authentication
- Authorization and Access Controls
- OS/DBMS/Network mechanisms
- Trusted processes (what are they, when are they needed)
- Virtualization
- Biometrics
- Audit, monitoring, anomaly detection, DLP
- Wireless, link, and signal security

3. Architectures
- Network models
- OS/DBMS/Network architectures
- OS/DBMS/Network subjects and objects (active entities and data containers)
- Cloud, Grid, distributed computing
- Custom/specialized architectures (e.g., Ad-hoc networks, SCADA)
- Interconnectivity and routing
- Privilege and separation issues
- Components vs. Solutions vs. Systems
- Critical infrastructure security

4. Assurance
- Software
- Hardware
- Testing (functional, penetration, black box, white box, measurement, etc.)
- Modeling and Formal methods (must focus on feasibility, applicability, strengths/weaknesses)

5. Operations
- Configuration
- Security automation
- Intrusion detection/analysis/remediation

6. Analysis
- Cryptanalysis
- Malware analysis
- Forensics
- Data mining
- Process
- Audit
- Certification and accreditation

7. Non-technical CD Issues
- Legal issues
- Policy issues
- Privacy
- Business Case / Economics
- Awareness
- Supply Chain