

# Lane Department of Computer Science and Electrical Engineering

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## Degrees Offered

- Masters of Science, Computer Science (M.S.C.S.)
- Masters of Science, Electrical Engineering (M.S.E.E.)
- Masters of Science, Software Engineering (M.S.S.E.)
- Doctor of Philosophy, Computer Engineering (Ph.D.)
- Doctor of Philosophy, Electrical Engineering (Ph.D.)
- Doctor of Philosophy, Computer Science (Ph.D.)

## Graduate Certificates Offered

- Graduate certificate in software engineering
- Graduate certificate in computer forensics
- Graduate certificate in biometrics & information assurance
- Graduate certificate in interactive technologies & serious gaming

## Overview of Programs

The Lane Department of Computer Science and Electrical Engineering offers master's programs leading to a master's of science in computer science (M.S.C.S.), a master's of science in electrical engineering (M.S.E.E.), and a master's of science in software engineering (M.S.S.E.). It also participates in the College of Engineering and Mineral Resources interdisciplinary program offering the master's of science in engineering (M.S.E.). Master of science students must comply with the rules for master's degrees as set forth by the college in the Guidelines for Masters Degree Programs Offered in the College of Engineering and Mineral Resources and by the Department in the Masters of Science Program Guidelines.

The department also offers programs leading to the doctor of philosophy (Ph.D.) in computer science and the doctor of philosophy (Ph.D.) in engineering with specialization in electrical engineering or computer engineering. Ph.D. in electrical or computer engineering students must comply with the rules set forth by both the College's Doctor of Philosophy Program Guidelines and by the Department in the Doctor of Philosophy Program Guidelines. Ph.D. students in computer and information sciences must comply with the rules set forth in the Handbook for Computer Science Graduate Students.

The department also offers four graduate certificates which may be completed as part of a degree program or as a certificate only.

## Program Educational Objectives and Outcomes

The common educational objectives of all the graduate programs in the Lane Department is to produce graduates who have the knowledge, skills, and attitudes that will ensure success in professional positions in business, industry, research, government service, or in further graduate or professional study. The requirements and outcomes of specific degree and certificate programs are described in the catalog pages specific to those programs.

## Facilities and Centers

The Lane Department of CSEE has its main office, instructional lab, and research lab space on the Evansdale campus occupying four floors of the Engineering Sciences Building and one floor of the Engineering Research Building. The department also has facilities located in Armstrong Halls on the downtown campus.

The department is home to two university research centers: the Center for Identification Technology Research (CITeR), which is designated an Industry/University Cooperative Research Center by the National Science Foundation; and the Center for Advanced Power & Energy Research (APEREC). The university is also designated as a Center of Excellence in Information Assurance Research by the National Security Agency and Department of Homeland Security. The department and college host a modern 4,000 square foot clean room facility for device and sensor fabrication, under the management of the university's Shared Research Facilities. The university is also home to an outstanding set of faculty-led laboratory facilities, in areas that include electronic and photonic material, biometrics, communications, digital and analog signal processing, power electronics, robotics, high reliability software, computer security, computer forensics, artificial intelligence, virtual environments, theoretical computer science, and electric vehicles.

All graduate students have access to a broad variety of computing platforms for both classwork and research. The department operates and maintains a variety of dedicated computer systems, clusters, and networks supporting both the instructional and research activities of the department. These systems include numerous Windows workstations and a cluster of Linux Servers. An additional laboratory by Hewlett-Packard supports large databases and medical informatics. Students have access to a rich set of software packages and tool suites available either on department systems or the College of Engineering and Mineral Resources systems. All department, college, and university computing resources are fully networked via Ethernet and FDDI with a campus-wide ATM backbone enabling interface to the statewide ATM network. All computing systems have internet access enabling

worldwide connectivity and access to several additional computing services via the Pittsburgh Supercomputing Center. The university is also a member of Internet2, of which faculty in the department are active participants.

## Areas of Research

The department is enthusiastically and vigorously involved in research, technical publication, and graduate instruction at the forefront of the field. Academic and research activity is organized into five areas:

- Electronics and photonics
- Systems and signals
- Computer systems
- Software and knowledge engineering
- Theory of computation

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## FACULTY

### CHAIR

- Brian Woerner - Ph.D. (Purdue University)  
Wireless Communications and Networking

### PROFESSORS

- Donald Adjero - Ph.D. (Chinese University of Hong Kong)  
Graduate Coordinator for Computer Science, Multimedia Information Systems (Image, Video, and Audio), Distributed Multimedia Systems
- Hany Ammar - Ph.D. (University of Notre Dame)  
Risk Assessment, Software Engineering, Biometrics, Performance and Dependability Analysis, Modeling and Evaluation of Parallel and Distributed Systems
- Muhammad Choudhry - Ph.D. (Purdue University)  
Graduate Coordinator for CpE & EE, Power System Control, DC Transmission, Stability, Power Electronics
- Parviz Famouri - Ph.D. (University of Kentucky)  
Analysis and Control of Electrical Machines, Motor Drives, Power Electronics, Electric Vehicles
- Ali Feliachi - Ph.D. (Georgia Institute of Technology)  
Power Systems, Large-Scale Systems, Control
- Powsiri Klinkhachorn - Ph.D. (West Virginia University)  
Microprocessor Applications, Computer Architecture, Binary and Non-Binary Logic
- Dimitris Korakakis - Ph.D. (Boston University)  
Semiconductor Growth, Nanotechnology, Photonic Devices, Biosensors
- Afzel Noore - Ph.D. (West Virginia University)  
VLSI Design and Testing, Software Engineering, Information Assurance and Biometrics
- Roy Nutter Jr. - Ph.D., P.E. (West Virginia University)  
Neural Networks, Microprocessor Systems, Computer Architecture, Computer Forensics
- Y. Ramana Reddy - Ph.D. (West Virginia University)  
Artificial Intelligence, Knowledge-based Simulation, Computer Graphics
- Krishnamurthy Subramani - Ph.D. (University of Maryland)  
Scheduling, Computational Biology, Computational Complexity, Polyhedral Combinatorics
- Matthew Valenti - Ph.D. (Virginia Polytechnic Institute and State University)  
Communication Theory, Wireless Systems, Error Control Coding

### ASSOCIATE PROFESSORS

- Xian-An Cao - Ph.D. (University of Florida)  
Nanofabrication, Opto-electronic Devices
- Elaine Eschen - Ph.D. (Vanderbilt University)  
Graduate Coordinator for CS Ph.D. CCDM Program, Design and Analysis of Algorithms, Graph Theory, Combinatorics
- Katerina Goseva-Popstojanova - Ph.D. (University Sv. Kiril i Metodij)  
Software Reliability Engineering, Distributed Systems, Computer Security, Dependability, Performance and Performability Assessment
- David Graham - Ph.D. (Georgia Institute of Technology)  
Analog Signal Processing
- Guodong Guo - Ph.D. (University of Wisconsin, Madison)  
Computer Vision, Biometrics, Human Computer Interaction

- Mark Jerabek - Ph.D., P.E. (Purdue University)  
Solid State Devices and Sensors, Electromagnetics
- Dimitris Korakakis - Ph.D. (Boston University)  
Semiconductor Growth, Nanotechnology, Photonic Devices, Biosensors
- Vinodkrishnan Kulathumani - Ph.D. (The Ohio State University)  
Wireless Sensor Actuator Networks, Scalable and Fault Tolerant Distributed Systems
- Xin Li - Ph.D. (Princeton University)  
Image Processing, Computer Vision, Pattern Recognition
- James Mooney - Ph.D. (Ohio State University)  
Associate Chair, Operating Systems, Computer Architecture, Software Portability and Standards, Computer Security and Forensics
- Daryl Reynolds - Ph.D. (Texas A&M)  
Statistical Signal Processing for Communications, Iterative (Turbo) Processing, Transmitter Pre-coding, Space-time Coding and Processing
- Natalia Schmid - Ph.D. (Washington University)  
Estimation and Detection, Biometrics, Information Theory, Statistical Signal and Image Processing
- Sarika Khushalani Solanki - Ph.D. (Mississippi State University)  
Power/Energy Conversion, Power Systems; Controls, Signals, and Systems
- Krishnamurthy Subramani - Ph.D. (University of Maryland)  
Scheduling, Computational Biology, Computational Complexity, Polyhedral Combinatorics
- Frances VanScoy - Ph.D. (University of Virginia)  
Programming Languages and Compilers, Multisensory Computing, High Performance Computing

## ASSISTANT PROFESSORS

- Thirimachos Bourlai - Ph.D. (University of Surrey)  
Biomedical Image Processing, Pattern Recognition
- Yuxin Liu - Ph.D. (Louisiana Tech University)  
Biotechnology/Bioengineering, BioMEMS and Microfluidics, Cellular Sensor, Tissue Engineering
- Yanfang Ye - Ph.D. (Xiamen University)  
Cybersecurity, Machine Learning

## RESEARCH ASSOCIATE PROFESSORS

- Alan Barnes - Ph.D. (California Institute of Technology)  
Ion Surface Interactions, Materials Growth and Automated Document Analysis
- Sumitra Reddy - Ph.D. (West Virginia University)  
Healthcare Informatics, Componentware, Intelligent Systems, Information Technology Evolution

## RESEARCH ASSISTANT PROFESSORS

- Jeremy Dawson - Ph.D. (West Virginia University)  
Nanotechnology
- Jignesh Solanki - Ph.D. (Pennsylvania State University)  
Tissue Engineering, Spinal Cord Injury Repair, Stem Cells, Molecular Neurobiology

## VISITING AND ADJUNCT PROFESSORS

- Gyungsu Byun - Ph.D. (University of California, Los Angeles)  
Digital Electronic Devices
- Bojan Cukic - Ph.D. (University of Houston)  
Software Engineering, High-Assurance Systems, Computational Intelligence, Fault-Tolerant Systems, Biometrics
- Nancy Lan Guo - Ph.D. (West Virginia University)  
Medical Information Systems
- Lawrence Hornak - Ph.D. (Rutgers University)  
Optics, Integrated Optics, Micro/Nano Structures and Devices, Biosensors, Biometrics
- V. Jagannathan - Ph.D. (Vanderbilt University)  
Distributed Intelligent Systems, Internet and Security Technologies
- Tim Menzies - Ph.D. (University of New South Wales)  
Software Engineering, Data Mining
- Arun Ross - Ph.D. (Michigan State University)  
Statistical Pattern Recognition, Biometrics
- Stephanie Schuckers - Ph.D. (University of Michigan)

Signal Processing, Biometrics

## LECTURERS

- Camille Hayhurst - M.S.C.S. (West Virginia University)  
Programming Languages
- Raymond Morehead - M.S.C.S. (West Virginia University). M.D. (Northwestern University)  
Biomedical Systems, Databases
- Cynthia Tanner - M.S.C.S. (West Virginia University)  
Graduate Coordinator for Software Engineering

## PROFESSORS EMERITI

- John Atkins - Ph.D. (University of Pittsburgh)
- Wils Cooley - Ph.D., P.E. (Carnegie Mellon University)
- William Dodrill
- Ron Klein - Ph.D. (University of Illinois)  
power systems, control, maglev technology
- Robert McConnell - Ph.D. (University of Kentucky)

## Admission Requirements for All Programs

All Masters and Ph.D. programs require applicants to provide the items below to be considered for admission. Specific programs may have additional requirements. Exception: These requirements do not apply to nontraditional students in the Certificate of Software Engineering program and M.S.S.E. program (see certificate program and M.S.S.E. program for more information):

- A minimum cumulative grade point average of 3.0 or equivalent, based on a 4.0 system.
- Three letters of reference.
- International students must demonstrate proficiency in communicating in English (a minimum TOEFL Score of 550, or iBT Score of 79, or IELTS Score of 6.5). (Students who have completed a recent four-year bachelor's degree in the USA need not submit these scores.)
- All graduate degree programs require the GRE general test, with a suggested score of either the 80th percentile on the quantitative part or 80th percentile total (verbal + quantitative + analytical).
- All graduate degree programs require an appropriate bachelors or master's degree for entry. Students lacking some foundation courses appropriate to a particular degree program may be assigned some remedial coursework as a condition of admission.
- See: Certificate in Software Engineering; Master of Science in Software Engineering for alternative admission requirements to those programs for working professionals.

## Regular, Provisional, and Non-Degree Admission

Students admitted into a program are designated as regular status or provisional. The department also admits students to non-degree status in the College of Engineering and Mineral Resources, but these students are not admitted to any specific program. Regular status is given to students who are qualified for unconditional admission to a specific program. Provisional status is given to students who have deficiencies to make up such as incomplete credentials or other reasons as identified by the graduate coordinator. In all cases, the student's letter of admission will state what must be done to attain regular status.

Provisional students must complete the requirements for transfer to regular status by the end of the semester in which they complete eighteen credit hours. Usually provisional students are not considered for graduate assistantships or tuition waivers.

Non-degree status is granted upon request to students meeting the minimum admission requirements. A non-degree student is one who wishes to take courses without seeking a formal degree. Non-degree students require permission of the instructor to take courses that are restricted to specific majors. There is no guarantee of eventual acceptance into a degree program, and in no case may more than twelve hours be transferred to a degree program.

Non-degree students may not be offered graduate assistantships or tuition waivers.

The Lane Department of Computer Science & Electrical Engineering offers four graduate certificates, which are typically completed as part of a graduate degree program but can be completed as a separate credential. Brief descriptions of the certificate programs are given here. More detailed information on procedures for the certificate programs may be found on the main department web page.

## Graduate Certificate in Software Engineering

Details for the Graduate Certificate in Software Engineering are found on the graduate catalog section devoted to the Master of Science in Software Engineering degree program.

## Graduate Certificate in Computer Forensics

### CERTIFICATE CODE - CG08

The Lane Department of Computer Science and Electrical Engineering (LDCSEE) offers a Graduate Certificate in Computer Forensics (CF). By providing systematic graduate courses in this field, our graduates and others should be better prepared to assist business, industry, government, and academia in attaining a new level of protection from cyber-criminals.

The graduate certificate program consists of fifteen credit hours of required courses. Admission to the graduate certificate program in Computer Forensics requires admission to the M.S. Computer Science or M.S. Electrical Engineering (with Computer Engineering major). One wishing to complete only the Certificate must still be admitted to the M.S.C.S. or M.S.E.E. programs.

The purpose of the certificate program is to:

1. Provide further education to computer professionals with technical undergraduate degrees to enable them to track and protect institutional computer and cyber crime. This knowledge in corporate settings should lead to better protection of company computer assets, company intellectual property, and company data and financial assets. These professionals should be able to support law enforcement in detection and prosecution of cyber-crime when needed.
2. Provide further education for those technical individuals who work in law-enforcement. It is expected that these would be highly technical people with bachelor's degrees in either computer science, computer engineering, or software engineering.

Many (if not most) of the students expected will be full time and pursuing a Masters of Science degrees in Computer Science or Computer Engineering. Other students may come from industry and law enforcement. These students will achieve the Certificate as another resume item that will improve employability while supplying a demand for computer people with such backgrounds. Some students may choose to pursue the Certificate with no intent of completing a Masters degree but will have achieved significant competence in this field.

The Certificate requires fifteen credit hours through required core curriculum courses. In addition to the fifteen credit hours upon course completion, the student will be required to complete a capstone project. The following are the fifteen credits hours:

#### Required Courses

CPE 435	Computer Incident Response	3
CPE 536	Computer Data Forensics	3
CPE 538	Intro Computer Security Management	3
CS 539	Computer Forensics and the Law	3
CS 568	Computer Network Forensics	3
Total Hours		15

These five courses cover the major areas of study. The first is an overview of the entire area; two will be taught with an emphasis throughout on vulnerabilities and counter-measures. One course emphasizes management practices and oversight required to maintain the best defense against attacks in organizations and how to respond to them. The final course deals with the law and cases governing the area of computer crime, its detection and prosecution, keeping in mind the constraints placed on security by the rights of citizens.

## Graduate Certificate in Biometrics & Information Assurance

### CERTIFICATE CODE - CG09

The graduate level Information Assurance and Biometrics Certificate Program at West Virginia University (WVU) provides a student-centered learning environment to educate and train professionals to meet the changing needs of the industry, government, and academia in West Virginia and the nation. This program is offered to WVU students, government personnel (military and civilian), and contractor personnel who meet the program acceptance requirements. Potential career options for students completing this certificate program are in security related fields, most likely in the military, banking industry, or within various law enforcement agencies.

The graduate level Information Assurance and Biometrics Certificate Program offered at WVU provides a broad overview of the information assurance and biometrics field and addresses relative and recent advances and current research issues. It is interdisciplinary in nature and covers many educational materials. Included are the elements of biometrics technology, system security engineering, and principles of trusted systems. The course content of this program emphasizes ethical, economic, social, and legal impacts of biometrics technologies and information assurance techniques.

The goal of the graduate level fifteen Credit Hour Information Assurance and Biometrics Certificate Program is to provide students with the following:

- A solid understanding of biometrics technology, system security principles, and their scientific foundations, and
- An awareness of the social, psychological, ethical, and legal policies and requirements in the field of information assurance and biometrics (IAB), and

- The ability to communicate with professionals in the wide range of public services, including law enforcement, military, science, and those who employ the principles and techniques of IAB.

The coursework includes fifteen credit hours of classes. As part of the certificate coursework, students will be expected to take four required classes and choose the fifth class between two approved electives.

#### Required Courses

BIOM 426	Biometric Systems	3
CS 465	Introduction to Cybersecurity	3
STAT 516	Forensic Statistics	3
BIOM 693	Special Topics	3
Select one of the following:		3
CS 665	Computer System Security	
EE 465	Introduction to Digital Image Processing	
Total Hours		15

A capstone project will be required as part of the Advanced Biometrics course. Advanced Biometrics is a required capstone course taken after BIOM 426, CS 465, and STAT 516. This course includes a once-a-week advanced topics seminar series and a three-hour laboratory. The laboratory will have both formal laboratory exercises and time devoted to the project. The project will provide the students with an opportunity to integrate the knowledge gained from the core courses to the program.

## Graduate Certificate in Interactive Technologies and Serious Gaming

### CERTIFICATE CODE - CG27

A graduate certificate in Interactive Technologies and Serious Gaming recognizes that interactive computer software such as games are both a programmed artifact and a cultural object, and careers in computer gaming - whether in academia or in industry - require a broad range of skills. The purpose of this program is to:

1. Give graduate students the skills required to conduct advanced research in gaming and interactive technologies.
2. Prepare students for careers in the gaming industry.
3. Foster a local gaming and interactive technologies program in West Virginia.

Admissions requirements for this certificate program are the same as the admission requirements for the M.S.C.S. degree program.

The Interactive Technologies and Serious Gaming Certificate Program will normally be completed over two years. Requirements for completion of the degree are eighteen credit hours of coursework and completion of a final project. The eighteen credit hours of coursework will include:

#### Required Courses

CS 572	Advanced Artificial Intelligence Techniques	3
CS 570	Interactive Computer Graphics	3
CS 593X	Special Topics (Design of Immersive Media)	3
Seminar		3
Electives		6
Total Hours		18

Prior to completion of the Certificate, students will complete a significant project, suitable for inclusion in their portfolio. The aim of the project is to synthesize and combine the student's prior study into an innovative product.

A graduate certificate in Interactive Technologies and Serious Gaming recognizes that interactive computer software such as games are both a programmed artifact and a cultural object, and careers in computer gaming - whether in academia or in industry - require a broad range of skills. The purpose of this program is to:

1. Give graduate students the skills required to conduct advanced research in gaming and interactive technologies.
2. Prepare students for careers in the gaming industry.
3. Foster a local gaming and interactive technologies program in West Virginia.

Admissions requirements for this certificate program are the same as the admission requirements for the M.S.C.S. degree program.

The Interactive Technologies and Serious Gaming Certificate Program will normally be completed over two years. Requirements for completion of the degree are eighteen credit hours of coursework and completion of a final project. The eighteen credit hours of coursework will include:

CS 572	Advanced Artificial Intelligence Techniques	3
CS 570	Interactive Computer Graphics	3
CS 593X	Special Topics (Design of Immersive Media)	3
Seminar		3
Electives		6

Prior to completion of the Certificate, students will complete a significant project, suitable for inclusion in their portfolio. The aim of the project is to synthesize and combine the student's prior study into an innovative product.