

COMPUTER SCIENCE

Introduction

The Computer Science program is part of the Department of Computer Science and Electrical Engineering which has 47 full-time teaching and research faculty, 7 full-time lecturers and over 15 affiliate and part-time adjunct faculty. The program has over 1,100 undergraduate and 270 graduate students. It is centered in the new Information Technology and Engineering (ITE) building, which has an excellent laboratory and computing environment.

Programs



Dr. Charles Nicholas, Chair
Computer Science and
Electrical Engineering

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Faculty: 47

Research Areas

Computer science research in the department is organized into seven broad areas, each of which has several faculty members and many associated students. Specific research topics within each area evolve along with technology and requirements.

Data and Knowledge Management

The world runs on information and storing, retrieving and managing it is critical to people and organizations. Current research in this area includes geographic information systems, bioinformatics and genomic databases, information retrieval, multimedia databases, semi-structured information, text understanding, web-based information systems semantic web and data mining. **Faculty:** *Yelena Yesha, Kostas Kalpakis, Padma Mundur, Charles Nicholas, Sergei Nirenburg, Hillol Kargupta, Tim Finin, Milt Halem.*

Graphics and Visualization

Understanding data using visualization and interactive graphics using graphics hardware are the core areas of computer graphics research at UMBC. Current research projects address realistic and non-realistic artistic graphics, procedural shading, computer animation, object modeling and representation, and design and use of graphics hardware. **Faculty:** *Penny Rheingans and Marc Olano.*

Algorithms and Theory

Understanding the theoretical and algorithmic bounds of computing and how to approach them with practical algorithms are foundations of computer science. Our faculty work on the theory of cryptography, complexity, quantum computing and scientific computing. **Faculty:** *Richard Chang, Sam Lomonaco, Brooke Stephens, Yaacov Yesha, and Alan Sherman.*

Systems and Networking

Networking and systems level programming are critical in providing distributed and ubiquitous computing. This is evident at all levels, from the simple operating systems embedded in handheld devices and sensors to distributed applications and services running across the Internet. Our faculty are working on real-time embedded systems, efficient protocols for wireless networks, and building secure and trusted computing systems. **Faculty:** *Krishna Sivalingam, Deepinder Sidhu, Anupam Joshi, and Mohamed Younis.*

Research Highlights

Securing Cyberspace. **Alan Sherman** directs the UMBC Center for Information Security and Assurance, which promotes research, education, and sound internal practices in information security and assurance. Through the efforts of the Center, UMBC has been designated by NSA as a Center of Academic Excellence in Information Assurance Education. Sherman's own research interests are wide ranging and include key management for large dynamic groups, cryptanalysis, applications of cryptography, information assurance education, and the theoretical foundations of cryptology.

Understanding text. **Sergei Nirenburg** heads the UMBC Institute for Language and Information Technology which combines basic research in language processing by computers with development of practical applications and knowledge acquisition tools. Applications include machine translation, information extraction from documents, and knowledge management.

Seeing is believing. **Penny Rheingans** is an expert in using interactive computer graphics techniques to visualize scientific information, allowing people to quickly understand data and relationships. Building on perceptual principles, she uses the power of color, texture, motion, and interactivity as display parameters for the visual representation of multivariate data.

Knowledge from data. **Hillol Kargupta** works with NASA and other agencies on problems requiring large scale distributed data mining. One project mines the continuous streams of data generated by most modern vehicles and allows continuous on-board monitoring of moving vehicles, identifying the emerging patterns, and reporting them to a remote control center over low-bandwidth wireless network connection. This offers many exciting possibilities for real-time on-board health monitoring, drunk-driving detection, driver characterizations, and security related applications for commercial fleet management.

Think wearable. **Zary Segall** explores concepts and wearable artifacts that proactively serve users by taking clues from the human body, human emotions and human situations. Human aware artifacts will be an essential part of the world of future mobility, health care, and fashion. His magicHat, for example, deconstructs the mobile phone and enhances it with components (GPS, digital compass, vibrators for navigation directions) with the goal of exploring the mobile interaction/annotation of physical and social spaces.

Intelligent Systems and Machine Learning

UMBC faculty are building systems that are aware of their context, adapt to and learn from their environment, communicate with other systems, and can represent and reason with symbolic knowledge. Active research areas include machine learning, data mining, context aware computing, software agents, intelligent interfaces, natural language processing, intelligent planning, semantic web, and expert systems. **Faculty:** *Marie desjardins, Tim Oates, Yun Peng, Hillol Kargupta, Tim Finin, Sergei Nirenburg, Marge McShane, Steve Beale, Anupam Joshi*

Mobile and Pervasive Computing

Wireless communication technologies are enabling ubiquitous access to computers devices, services and people. We are pursuing many problems including service discovery and matching, sensor networks, security, privacy and trust for wireless environments, and wearable computing. **Faculty:** *Anupam Joshi, Yelena Yesha, Zary Segall, Tim Finin, Mohamed Younis*



Information Assurance and Security

Information Assurance encompasses the scientific, technical, and management disciplines required to ensure computer and network security, protect and defend information and information systems by ensuring their availability, integrity, authentication, confidentiality, and nonrepudiation. Current research involves cryptography and crypanalysis, key management, intrusion detection, wireless security, and novel approaches to security education and training. **Faculty:** *Alan Sherman, John Pinkston, Anupam Joshi, Brooke Stephens.*

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About UMBC

The University is a thriving center for research and development and technology commercialization. Campus research grants and training contracts have topped \$85.5 million, up from \$10 million nine years ago. Patent applications by UMBC researchers have more than quadrupled in three years and more than 125 University-developed technologies are available for licensing.

Adjacent to the campus, the techcenter@UMBC is a magnet for high-technology business development and offers a dynamic, fully-equipped facility for start-up and emerging companies. Its specialized environment promotes strategic alliances among tenants and connections with the UMBC faculty, students and companies in the region. UMBC is a member of Internet 2 with high-speed Internet connectivity.

Recent Collaborations

Tim Finin heads a distributed, interdisciplinary research project exploring the use of semantic web technologies in support science in general and the field of ecoinformatics in particular. Partners include the University of Maryland, College Park, the University of California, Davis, the Rocky Mountain Biological Laboratory and the NASA Goddard Space Flight Center with additional collaborators from the USGA and other federal agencies.

Anupam Joshi and his colleagues from the Ebiquty Lab are working with researchers from Nokia, Fujitsu, Hewlett Packard and IBM to prototype intelligent information systems for mobile and pervasive computing environments. The goal is to engineer environments where computers, devices, sensors, and software agents, supported by a common wireless communication infrastructure, work seamlessly together to support people pursuing their everyday tasks.

Marc Olano with colleagues at ATI Technologies Inc are working on new optimization approaches for procedural shading. Procedural shading is a technique for producing more complex and realistic object appearance in computer graphics, and is used heavily in interactive applications and games. Dr. Olano is also working with XMTT, Inc., of College Park, Maryland, to measure and evaluate the promise of a new parallel processing chip architecture for use in computer graphics hardware systems.

Marie desJardins and colleagues at the Jet Propulsion Laboratory are developing methods to learn user preferences in order to prioritize scientific data, such as images to be sent over a limited-bandwidth downlink. Dr. desJardins with Dr. Penny Rheingans, Dr. Tim Oates, and collaborators at the University of Maryland College Park are developing interactive tools for visualizing gnad modeling dynamic patterns in time-varying relational databases, such as scientific collaboration networks.

Mohamed Younis and members of his lab are addressing the technical challenges for designing dependable embedded systems and networks found in wide range of applications such as aerospace electronic systems, remote sensing, etc. Collaborators include the University of Maryland, College Park, Virginia Tech, Old Dominion University, NASA Langley Research Center, National Security Agency and Honeywell International.

Krishna Sivalingam leads the DAWN research group that conducts research on optical networking with emphasis on resilient network design that can withstand network failures, with support from Intel, Cisco and the National Science Foundation. His group is also involved in designing power-aware and secure network protocols and localization systems for wireless networks including wireless sensor networks.

Educational Programs

The Computer Science program offers a wide range of undergraduate and graduate courses and degree programs. Many courses are offered in the evening for the convenience of part-time students and people who are just interested in broadening or deepening their knowledge. Courses range from basic foundations, to advanced topics courses, to special seminars on cutting edge problems and technologies. A regular public seminar series lets our community hear about the latest research going on both within UMBC and across the world.

Student Interns

Many of our undergraduate and graduate students are available for and interested in working on a part-time basis or as interns or cooperative work-study students. Recent internships have included international, national and local companies as well as state and federal government agencies.

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