

Request for a New Graduate Certificate Program
Department of Computer and Information Science
School of Science, IUPUI

Cyber Security Certificate

To be offered as a Purdue Certificate at IUPUI
May 30, 2005

Purpose of the Program

IUPUI's mission is to serve Indiana by providing the best possible educational experience for the population and the greatest possible growth in knowledge resources in support of the state's business, industrial and governmental activities. In this effort, it is striving to be the exemplary "Urban University."

In support of the university's mission, the department's mission is to build excellent academic programs coupled with strong research programs, industrial collaborations and community relationships. The three pillars supporting this mission are its Graduate, Undergraduate and Service Course Programs. The dynamics of Indiana, particularly in the Indianapolis area, obligate the department to not only continue, but increase this effort. The department has a key role to play in satisfying the information technology needs of the surrounding community and guiding their development.

In order to increase the Graduate Program's ability to support the department's mission, the department proposes to broaden and enrich its curriculum in anticipation of the rapidly growing trends in information technology, particularly as it is manifesting itself in the Indianapolis area. The objective of the proposed Graduate Certificate Program in Cyber Security is to develop in the student skills and knowledge of the computer science fundamentals and an ability to apply these to practical problems as it relates to Cyber Security. Another objective of this program is to provide an integrative experience by applying to a complex problem of a practical nature the theory and skills learned in the course work. The graduate of this program is prepared to adapt and respond quickly to the employer's specialized requirements.

The program in Cyber Security will explore concepts and principles of cryptography and network security, including classical and modern cryptography, cryptanalysis, secret key cryptosystems, public key cryptosystems, digital signature and authentication, hash functions and message digest, key distribution and key management, network security protocols. The focus of this program is on theoretical, practical, and application aspects of cryptosystems and security protocols in network systems such as the Internet. The goal of this program is for the participant to acquire an understanding of the concepts and principles of cryptography and network security, and to have a hands-on experience in the practice and application of cryptosystems, security protocols and current network security standards. By the end of the program, the successful graduates will know: what are network security threats and attacks, what are security requirements of computer and network systems, what are techniques enforcing security requirements and how to implement these techniques/protocols.

Relation to existing certificate programs

This program has no relation to existing certificate programs. However, the program is a complement to our existing undergraduate and M.S. programs.

The target audience

The location of the IUPUI campus is unique within the state and the need for targeted computer science certificate programs is unique to the population and companies within the metropolitan area. Our current research activities involves local community affiliation and collaboration. The community includes the local industries such as Eli Lilly & Co., Raytheon, and the IU Medical School. All of these entities in the local community have application domains which have the need for high quality fundamental research. This program will allow employees of these local industries to establish collaborations with our research faculty while at the same time providing them with the skills necessary to introduce these initiatives within their companies.

Plan for sustaining steady-state enrollment

In the first year (Fall 2005), five students will likely participate in the program. It is anticipated that this number will rise rapidly to ten per year in the next two to three years, as the awareness of the program increases. The potential exists for much greater growth beyond this subsequently.

New resources

No new resources are needed. All courses are currently taught at IUPUI by existing faculty.

Proposed date of the initiation of the certificate program

Proposed date of implementation is Fall 2005, assuming all necessary approvals have been met.

Persons designated as the certificate program head

Dr. Pamala Crowell, Associate Dean for Research and Graduate Programs, School of Science, will provide the school administrative oversight.

Dr. Mathew Palakal, Professor and Chair, Department of Computer and Information Science will provide the department administrative oversight.

Dr. Xukai Zou, Assistant Professor, Department of Computer and Information Science will advise students.

Faculty initially involved in the program and their credentials**Omran Bukhres****X3801**

Ph.D., North Dakota State University, 1990

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Dr. Bukhres is the co-principal investigator of the Large Scale Distributed Computing and Multimedia Laboratory.

Research focuses: (1) database management systems for multimedia data, and (2) seamless integration of the distributed multimedia databases. Other research interests include: Transaction and Workflow Management,

Multimedia Databases, Interoperability and Recovery in Heterogeneous Distributed Database Systems, Knowledge Base and Expert Systems, Mobile and Client Server Computing.

Yuanshun Dai**X0458**

Ph.D. in Computer Science, National University of Singapore, September 2003

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Computing Systems Reliability, Software/Hardware Reliability, Grid Computing, Parallel/Distributed Computing, Fault Tolerant Computing, System Modeling are Dr. Dai's specialties.

Shiaofen Fang**X0329**

Ph.D., University of Utah, 1992

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Computer graphics, scientific visualization and geometric modeling are Dr. Fang's research specialties. Currently he is collaborating with biomedical researchers to apply computer graphics and visualization techniques, in particular volumetric modeling and visualization, for medical imaging applications.

Jeffrey Huang**X0375**

Ph.D., George Mason University, 1998

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Jeffrey Huang's specialties and research interests include image processing, pattern recognition, computer vision, machine learning, and Evolutionary Computation (EC) on the applications of face recognition, Human Computer Interaction (HCI) and the interpretations of human activities, multimedia, computer visualization, medical imagery, and Automated Target/Object Recognition (ATR) and detection.

Snehasis Mukhopadhyay**X0313**

Ph.D., Yale University, 1994

Email address: smukhopa@cs.iupui.edu 317-274-9732

Current research interests are adaption and learning in multi-level and distributed systems; information filtering and retrieval; modeling, simulation analysis and adaptive control of complex nonlinear systems using neural networks; design and analysis of intelligent controllers. Dr. Mukhopadhyay received a National Science Foundation Career Award.

Mathew Palakal**X0199**

Ph.D., Concordia University, 1987

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The development of Artificial Neural Network (ANN) models as learning and decision-making systems for various AI-related problems are of primary interest. He is involved in projects that include modeling Biosonar systems, neural network models to predict damages in materials and structures, and distributed information filtering.

Rajeev Raje**X0328**

Ph.D., Syracuse University, 1994

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Dr. Raje is interested in the system and application aspects of the distributed-object model of computing. His current projects include the development of a seamless environment for net-centric applications, distributed information filtering, collaborative software engineering and visualization environments, and enhancement of different distributed-object models.

Mihran Tuceryan**X0336**

Ph.D., University of Illinois-Urbana Champaign, 1986

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Dr. Tuceryan's research interests include augmented reality, model-based video coding, 3D computer graphics, 3D computer vision, and pattern recognition. Augmented Reality combines technologies from 3D computer graphics, visualization, advanced user interfaces, and 3D computer vision.

Completion requirements and audit and certification procedures

Course Requirements: 12 graduate credit hours are required. These include:

- One core course (3 credits),
- Three specialization courses (9 credits).
- **Specific Requirements**
 - Core: 580 (Algorithms)
 - 590 (Network Security)
 - 590 (Information Assurance)
 - 536 (Networks)

Minimum overall GPA

Successful completion of the certificate requires at least a B average over all courses counting towards the certificate. Courses with a grade of C- or less must be taken again to count towards the certificate. The minimum grade that will be accepted in any single course is C.

Maximum number of credits that can be transferred from another institution

Applicants who have already earned credit for one or more of the equivalent courses from other institutions and other certificate programs may request to apply up to a maximum of three credits of these courses toward this certificate. Any waivers or substitutions have to be approved by the committee that oversees the program.

Maximum number of undergraduate courses that can be applied

No undergraduate courses can be applied to this certificate program.

Maximum time for completion

All requirements for the certificate must be completed within three years. Most students enrolled in this program will be part-time students, employed full time. Thus two years may be needed for the completion of all courses if students take one course per semester.

Number of credit hours taken prior to admission to the certificate program that may be counted to completion of the degree

Up to 6 equivalent credit hours taken prior to admission to the certificate program, including 3 hours taken from another institution, will be counted towards the certificate. The rest of the courses must be completed at IUPUI within a three-year period from the time of admission.

Course lists for the program including course descriptions

580 Algorithm Design, Analysis, and Implementation (3 cr.) P: 463 and 470. Basic techniques for designing and analyzing algorithms: dynamic programming, divide-and-conquer, balancing, upper and lower bounds on time and space costs, worst case and expected cost measures. A selection of applications such as disjoint set union/find, graph algorithms, search trees, pattern matching. The polynomial complexity classes P, NP, and co-NP; intractable problems.

536 Data Communication and Computer Networks (3 cr.) P: 402. Data communications: communication hardware technologies including local area and long-haul network hardware, circuit and packet switching, interfaces between computer and network hardware, and performance issues. Network architecture: protocol software and conceptual layering, reliable delivery over an unreliable channel, transport protocols, virtual circuits, datagrams, Internet working as a fundamental design concept, the client-server paradigm, naming and name binding, name servers, addressing and address resolution, routing and routing algorithms, congestion and flow control techniques, network file systems, distribution of computation, DARPA Internet protocols (TCP/IP) as examples of protocol organization.

590 Network Security (3 cr.) This is an introductory level course on the concepts and principles of cryptography and network security, including classical and modern cryptography, cryptanalysis, secret key cryptosystems, public key cryptosystems, digital signature and authentication, hash functions and message digest, key distribution and key management, network security protocols. The focus of this class is on practical aspects and application of cryptosystems and security protocols in network systems such as the Internet.

590 Information Assurance (3 cr.) The course will cover the basic concepts of information security, basic techniques for different security requirements, security models, and security policies. The topics can be selected from the following: Basic notions of confidentiality, integrity, availability; authentication models; protection models; security kernels; secure programming; computer viruses and malware; intrusion detection and response; network firewalls; access controls; information flow; identification and authentication in local and distributed systems; audit; operational security issues; physical security issues; personnel security; policy formation and enforcement; legal and social issues; classification and trust modeling; risk assessment.

Procedures for governing the program including construction of committees that will provide oversight

A committee comprised of Dr. Mathew Palakal, Dr. Xukai Zou and Dr. Yuanshun Dai will jointly oversee the program. All advising will be done by these faculty members. The Department of Computer and Information Science and Ms. Myla Langford, the graduate coordinator, will take responsibility for all record keeping and tracking of students.

Procedures for program evaluation including the criteria for success

Upon completion of the program, exit interviews will be conducted for all students to determine the effectiveness of the program in meeting their needs and to identify how they are using the skills and tools learned in the program in their professions. Follow-up interviews will be conducted after three and five years. Given the projected enrollment of this program, and the fact many of the graduates will remain employed locally, it is anticipated that most students will be tracked this way.

Success of the program will be defined in terms of demand (enrollment) and the responses of the students surveyed upon completion of their degree and in the follow-up interviews.