Graduate Affairs Committee:

October 5 Agenda

Graduate Affairs Committee

October 5, 2005

3:30 p.m. - 5:00 p.m.

UL 1126

1.	Approval of the minutes for June 28, 2005	Queener
2.	IU Dean's Report • Personnel changes in the graduate School • Time frame for Dean's Search	Queener
3.	Graduate Office Report	Koerner
4.	Graduate Student Organization Report	Robinson
5.	Committee Business	
	• Curriculum Subcommittee Report	O'Palka
	• Fellowship Subcommittee Report	Koerner
6.	Program Information • Computer Science Graduate Certificates • MS in Health sciences	Queener
7.	Discussion - Current state of the GND program • Hiring new Coordinator • GND enrollments and outcomes • Advising issues, including pre-Med	
8.	Next Meeting (November 2, 2005) and adjournment	

IUPUI Graduate Office
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This page last modified on March 27 2006

Graduate Affairs Committee :

October 5, 2005 Minutes

Present: Margaret Adamek, Rachel Applegate, Mark Bannatyne, Paul Carlin, Pamela Crowell, David Ford, David Handel, Elisabeth Hinshaw-Osgood, Dolores Hoyt, Marvin Kemple, Joyce Mac Kinnon, Craig McDaniel, Jackie O'Palka, Robert Osgood, Sherry Queener, Simon Rhodes, Sharon Sims, James Williams, Marianne Wokeck.

Guest: Mathew Palakal, PhD.

Staff: David Koerner, Dswanda Jones.

Approval of the Minutes - Dr. Queener

Minutes from the June 28, 2005 Meeting Approved.

IU Dean's Report – Dr. Queener

Dean Slattery has left IU for another position, Dean Kintgen and Dean Queener have assumed co-interim Dean positions to fill in until the new IU Dean is hired. They have agreed that the Graduate Council should return. They aren't sure of the council's tasks but Dr. Queener will keep the committee informed. They will also reconstitute a few of the subcommittees but the Curriculum Subcommittee will not return, the GAC will remain the final decision maker on approving programs that go directly to the ALC.

Graduate Office Report – Mr. Koerner

The Graduate Office now has one main number: 274-1577. Debra Sullivan has received the Irwin Award. The new office space for the Graduate Office on the second floor of the Union Building has been approved; the move will take place in March.

Meningitis Compliance - the Registrar's Office will be sending a message to any students who are still not compliant with the meningitis warnings when they try to register for Spring classes. Students need to go to the website (http://registrar.iupui.edu/meningitis.htm), acknowledge that they have been notified of the dangers of meningitis as well as the locations for immunizations if the student so chooses. While immunization is not required, students should carefully read this information and make an informed choice about whether to get immunized. Students who do not visit the website and acknowledge that they have received this information will be prevented from registration for Spring 2006 until they take action.

Graduate Student Organization Report – Mr. Koerner

The GSO has distributed 90% of funds for the Fall; final distribution will be December for the Spring. The GSO meetings are now in the Union Building once a month.

Committee Business

Curriculum Subcommittee Report **- Dr. O'Palka**

The committee met September 30th. Of the New Courses submitted, two were Approved, 2 were Not Approved, 2 are Pending with minor changes and 10 courses were sent back to the submitter. The committee Approved 10 course changes, 2 are Contingent with minor changes, and 4 were sent back.

Dr. Queener reported that the Master Course List. No longer exists for the whole university but is kept on each campus. Dr. Queener will keep the committee updated on this progress.

Fellowship Subcommittee Report **- Mr. Koerner**

The Block Grant funds were transferred before the start of the Fall semester.

Coming Home Fellowship - Dr. Queener reported the idea of awarding a graduate fellowship to Indiana residents who went to High School in Indiana but left the state to attend college. This fellowship will also be available to award funds to Native Americans whose tribes are native to Indiana. She has located $40,000 that she can put towards this effort; she's asking the schools to offer in-state fees to these students.

Program Information - Dr. Queener

- *Computer Science Graduate Certificates* - Dr. Palakal gave a brief synopsis of five certificates – Bioinformatics, Biometric Computing; Cyber Security; Database and Datamining; and Software Engineering. The certificates should be ready for voting at the next meeting.
- *MS in Health Sciences Education* – The GAC approved this degree in January 2004 under the title of MS in Health and Rehabilitation Sciences. Bloomington is now stating that the proposal is not approved as a Graduate degree. Dr. Queener has re-sent the proposal for review; she asked the committee to decide if they stand by the original vote. The committee voted to re-approve the proposal as a Graduate degree. Dr. Queener will relay this information to IUB.

Discussion

- *Current State of GND Program* – The new GND Coordinator will start November 1st. Numbers of students in the program are steady.
- *Advising Issues* – There is an idea to create a new advising incentive, but the initiative will use CTE money, which cannot be used for graduate students. Therefore, GND students might be disqualified from using this service. Dr. Queener is in negotiation with administration on this point and will keep the committee informed.
- *Mission Differentiation* – Dean Slattery was translating the Mission Differentiation document into a set of guidelines to help campuses of Indiana University figure out what it takes to realistically mount new graduate programs. Dean Queener is now assuming this task, along with Dean Kintgen. They are hoping to present it a document to the Board of Trustees in February; it will be available for review shortly.

Next Meeting

November 22, 2005

Meeting Adjourned 4:40 pm

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INDIANA UNIVERSITY
PURDUE UNIVERSITY
INDIANAPOLIS

MEMORANDUM

FOR: Dean Plater and Dean Manlove

FROM: Mathew Palakal Mathew J Palakal

DATE: September 2, 2005

SCHOOL OF SCIENCE

IUPUI

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.

During the Spring 2005 semester, the faculty in the Department of Computer and Information Science evaluated our current graduate program options and the idea to provide graduate certificates targeted at working adults in the Indianapolis community. Through discussions with the Computer Science Advisory Committee and members and our Graduate Committee, we have developed and submitted proposals for five graduate certificates.

The School of Science Graduate Affairs Committee has reviewed the proposals and recommended their submission for approval to the campus Graduate Affairs Committee. This will be presented by Pam Crowell at the next meeting on September 27th. The complete proposals are attached and submitted for your information and for format review. A summary of each certificate follows:

Biometric Computing Certificate: This program aims 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. Biometrics is defined as the capture of the physiological and behavioral characteristics for personal identification and / or individual verification purposes. Since it uses individual personal characteristics to verify or recover identity, it is set to become a successor to the personal identification token. The technique of using biometric methods for identification can be widely applied to forensics, ATM banking, communication security, time and attendance, and access control

DEPARTMENT OF COMPUTER
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Database and Datamining Certificate: This program will introduce students to the core concepts necessary for the design, implementation, and application of database systems. It stresses the fundamental principles in database modeling and design. The aim is to address the continuing need for engineering databases for complex and ever changing applications requiring security, performance, and reliability.

Bioinformatics Certificate: The explosive growth of biological genetic information sources, available over the Internet, has given rise to both opportunities and challenges for biological and medical researchers. The opportunities they provide are both scientific (e.g., understanding the information encoded in elementary biological structures) as well as technological (e.g., new drug discovery for specific diseases). Students earning a Bioinformatics Certificate will be able to participate in the development of agent-based information systems that have the potential to scale up to a broad range of complex information services.

Software Engineering Certificate: A central problem of today's economical development and competitiveness in industry, society, science and engineering is the mastering of complex, large, heterogeneous, software-intensive products and the processes of their construction, application and adaptation. The success of software products and services as well as of enterprises and organizations is increasingly determined by the availability of such adequate software solutions.

Cyber Security Certificate: 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.

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

Bioinformatics 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 Bioinformatics 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 Bioinformatics. 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 explosive growth of biological genetic information sources, available over the Internet, has given rise to both opportunities and challenges for biological and medical researchers. The opportunities they provide are both scientific (e.g., understanding the information encoded in elementary biological structures) as well as technological (e.g., new drug discovery for specific diseases). The challenges, on the other hand, lie in how to discover, among the vast volume of data, the items that are relevant or interesting to a given researcher, without an undesirable amount of effort and work load.

The complete information system development is based on an agent-society framework where the elementary information services such as resource discovery and information retrieval, representation, classification, and user interaction are carried out autonomously by independent software units (called agents), and the large-scale information activity is accomplished by means of collaboration between these elementary agents. Such a conceptual agent-based information system is innovative and has the potential to scale up to a broad range of complex information services.

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. Snehasis Mukhopadhyay, Associate 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
Email address: bukhres@cs.iupui.edu 317-274-8674
Personal Web Page: http://www.cs.iupui.edu/~bukhres
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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Personal Web Page: http://www.cs.iupui.edu/~ydai
Computing Systems Reliability, Software/Hardware Reliability, Grid Computing, Parallel/Distributed Computing, Fault Tolerant Computing, System Modeling are Dr. Dai's specialties.

Shiaofen Fang **X0329**
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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**
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Email address: huang@cs.iupui.edu 317-274-9746
Personal Web Page: http://www.cs.iupui.edu/~huang
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**
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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., Syracus 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**
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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.

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Dr. Zheng's research interests include Computer Vision, 3D Modeling, Dynamic Image Processing Image Processing, Multimedia, Internet, Scene Representation Graphics, Virtual Reality, Digital Museum Sensor Information Processing, Robotics

Xukai Zou **X0422**
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Applied cryptography and network security, Secure group communication: dynamic key, management, key agreement and distribution, Access control in distributed systems, Authentication and digital signature, data integrity and hash functions, Communication networks and wireless/mobile networks, Software engineering and Web/Internet technologies, Design and analysis of computer algorithms, Data/image processing compression.

Admissions requirements and procedures

General Admission Requirements for the Graduate Certificate in Bioinformatics

Academic Standing

The applicant's record should exhibit outstanding achievement as indicated by the grade point average (GPA) for each degree over his or her entire academic record. An applicant is expected to have at least a 3.0 GPA on a scale of 4.

Core Background Requirements

All Graduate Certificate applicants should have a background in the following core areas of computer science:

- Data Structures and Algorithms.
- Theory (discrete math and theory of computation).

In addition, applicants should have a strong background in mathematics, including calculus, linear algebra, and in numerical computations. For students who do not have a degree in Computer Science or related field, CSCI 362 (Data Structures) or an equivalent course is required with a grade of B+ or better.

TOEFL Scores for International Students

All Graduate Certificate applicants whose native language is not English must submit a Test of English as a Foreign Language (TOEFL) score of at least 550 on paper based TOEFL and 250 on computer based TOEFL, or pass an equivalent test administered by IUPUI. These criteria are minimum requirements and the Department of Computer and Information Science may use additional criteria to make admission decisions. Potential applicants who have questions are advised to contact a Graduate advisor in the department.

Students admitted directly to the Computer Science Master of Science graduate program may earn this certificate in conjunction with their M.S. degree provided that all the requirements of the certificate program are satisfied.

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**
  1. Core: BIO 322 (Genetics) or BIO 507 (Molecular Biology) or CSCI 580 (Algorithms)
  2. 548 (Introduction to Bioinformatics)
  3. 590 (Intelligent Systems) or 590 (Data Mining)
  4. 541 (Database Systems) or 550 (Computer Graphics)

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
One undergraduate course in Biology 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

BIOL K322 Genetics and Molecular Biology (3 cr.) P: K103 and CHEM C106. Fall, day. Spring of even-numbered years. The course covers the principles of classical and molecular genetics including Mendelian inheritance, linkage, nucleic acids, gene expression, recombinant DNA, genomics, immunogenetics, and regulation.

BIOL 507 Principles of Molecular Biology (3 cr.) P: K322, CHEM C342, or consent of instructor. Fall, night. Molecular aspects of structure and function of nucleic acids and proteins, including recombinant DNA research. Prokaryotic and eukaryotic molecular biology are given equal weight.

CSCI 548 Introduction to Bioinformatics (3 cr.) P: 340, BIOL K483, CHEM C483, or MATH 511. Analysis of biological data employing various computational methods to obtain useful information in the emerging area of bioinformatics. Topics include: structures, functions and evolution of proteins and nucleic acids, retrieval and interpretation of bioinformation from the Internet, learning principles, algorithms and software for sequence alignment, similarity search of sequence databases, estimation of phylogenetic trees, structural prediction, and functional inference.

CSCI 541 Database Systems (3 cr.) P: 443 or equivalent. Spring. Fundamentals for the logical design of database systems. The entity-relationship model, semantic model, relational model, hierarchical model, network model. Implementations of the models. Design theory for relational databases. Design of query languages and the use of semantics for query optimization. Design and verification of integrity assertions, and security. Introduction to intelligent query processing and database machines.

CSCI 550 Computer Graphics (3 cr.) An introduction to computer graphics. Topics include the concepts, principles, algorithms, and programming techniques in 3D interactive computer graphics. Emphasis is on the development and applications of 3D graphic algorithms and methods.

CSCI 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.

CSCI 590 Intelligent Systems (3 cr.) This course will discuss problems in the area of intelligent systems. Topics include the formalisms within which these problems are studied, the computational methods that have been proposed for their solution, and the real-world technological systems to which these methods have been applied.

CSCI 590 Datamining (3 cr.) This course introduces the core concepts necessary for the design, implementation, and application of database systems. It stresses the fundamental principles in database modeling and design. The aim is to address the continuing need for engineering databases for complex and ever changing applications requiring security, performance, and reliability. The teaching approach will be both instructional and researching. The course emphasizes fundamentals for the logical design of database systems, the entity-relationship model, semantic model, hierarchical model, network model implementations of the models, design theory for relational database, design of query languages and the use of semantics for query optimization, design and verification of integrity assertions and security, and introduction to intelligent query processing and database machines.

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

A committee comprised of Dr. Mathew Palakal, Dr. Snehasis Mukhapadhyay and Dr. Jeffrey Huang 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.

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

Biometric Computing Certificate

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

Purpose of the Program

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With an increasing reliance on online technology and other shared resources, the information age is quickly revolutionizing the way transactions are initiated and completed. Business transactions of all types are increasingly being handled online; this unprecedented growth in electronic transactions has underlined the need for a faster, more secure, and more convenient method of user verification than passwords can provide. Using biometric identifiers offers several advantages over traditional and current methods. This is because only biometric authentication is based on the identification of an intrinsic part of a human being.

Biometrics is defined as the capture of the physiological and behavioral characteristics for personal identification and / or individual verification purposes. Since it uses individual personal characteristics to verify or recover identity, it is set to become a successor to the personal

identification token. The technique of using biometric methods for identification can be widely applied to forensics, ATM banking, communication security, time and attendance, and access control. And it also plays an important role in enhancing homeland security.
A biometric system is essentially a pattern recognition system which makes a personal identification by determining the authenticity of a specific physiological or behavioral characteristic possessed by the user. An important issue in designing a practical system is to determine how an individual is identified. Depending on the context, a biometric system can be either a verification (authentication) system or an identification system. In this program we will introduce the principle of various biometric technology including face recognition, fingerprint identification, iris identification, voice recognition, DNA matching and the fundamental computational methods for implementation. Some of the topics include: authentication technologies, biometric systems, sensor and signal processing, face recognition, eye biometrics, fingerprint identification, and DNA matching.

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.

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Dr. Mathew Palakal, Professor and Chair, Department of Computer and Information Science will provide the department administrative oversight.
Dr. Jeffrey Huang, 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
Email address: bukhres@cs.iupui.edu 317-274-8674
Personal Web Page: http://www.cs.iupui.edu/~bukhres
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**
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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**
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Personal Web Page: http://www.cs.iupui.edu/~sfang
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
Email address: huang@cs.iupui.edu 317-274-9746
Personal Web Page: http://www.cs.iupui.edu/~huang
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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Personal Web Page: http://www.cs.iupui.edu/~mpalakal 317-274-9735
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**
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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**
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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.

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Dr. Zheng's research interests include Computer Vision, 3D Modeling, Dynamic Image Processing Image Processing, Multimedia, Internet, Scene Representation Graphics, Virtual Reality, Digital Museum Sensor Information Processing, Robotics

Xukai Zou **X0422**
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Email address: xkzou@cs.iupui.edu
Web Page: http://www.cs.iupui.edu/~xkzou 317-278-8576
Applied cryptography and network security, Secure group communication: dynamic key, management, key agreement and distribution, Access control in distributed systems, Authentication and digital signature, data integrity and hash functions, Communication networks and wireless/mobile networks, Software engineering and Web/Internet technologies, Design and analysis of computer algorithms, Data/image processing compression.

Admissions requirements and procedures

General Admission Requirements for the Graduate Certificate in Biometric Computing

Academic Standing

The applicant's record should exhibit outstanding achievement as indicated by the grade point average (GPA) for each degree over his or her entire academic record. An applicant is expected to have at least a 3.0 GPA on a scale of 4.

Core Background Requirements

All Graduate Certificate applicants should have a background in the following core areas of computer science:

- Data Structures and Algorithms.
- Theory (discrete math and theory of computation).

In addition, applicants should have a strong background in mathematics, including calculus, linear algebra, and in numerical computations. For students who do not have a degree in Computer Science or related field, CSCI 362 (Data Structures) or an equivalent course is required with a grade of B+ or better.

TOEFL Scores for International Students

All Graduate Certificate applicants whose native language is not English must submit a Test of English as a Foreign Language (TOEFL) score of at least 550 on paper based TOEFL and 250 on computer based TOEFL, or pass an equivalent test administered by IUPUI. These criteria are minimum requirements and the Department of Computer and Information Science may use additional criteria to make admission decisions. Potential applicants who have questions are advised to contact a Graduate advisor in the department.

Students admitted directly to the Computer Science Master of Science graduate program may earn this certificate in conjunction with their M.S. degree provided that all the requirements of the certificate program are satisfied.

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).
- **Biometrics**
  1) Core: STAT 511 (Statistics) or 590 (Pattern Recognition)
  2) 590 (Biometrics Computing)
  3) 590 (Intelligent Systems) or 590 (Data Mining)
  4) 590 (Image Processing and Computer Vision) or 550 (Computer Graphics)

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

STAT 511 Statistical Methods I (3 cr.) P: MATH 164. Descriptive statistics; elementary probability; random variables and their distributions; expectation; normal, binomial, Poisson, and hypergeometric distributions; sampling distributions; estimation and testing of hypotheses; one-way analysis of variance; correlation and regression.

CSCI 590 Intelligent Systems (3 cr.) This course will discuss problems in the area of intelligent systems. Topics include the formalisms within which these problems are studied, the computational methods that have been proposed for their solution, and the real-world technological systems to which these methods have been applied.

590 Pattern Recognition (3 cr.) This course covers the fundamental techniques of statistical pattern recognition and clustering analysis. It looks at traditional applications of pattern recognition techniques as well as newer applications such as data mining. This is not a primarily or exclusively data mining course. Its main focus is pattern recognition, with data mining as one of the application domains.

550 Computer Graphics (3 cr.) An introduction to computer graphics. Topics include the concepts, principles, algorithms, and programming techniques in 3D interactive computer graphics. Emphasis is on the development and applications of 3D graphic algorithms and methods.

590 Data Mining (3 cr.) *Data Mining* is an analytic process designed to explore data (usually large amounts of data - typically business or market related) in search of consistent patterns and/or systematic relationships between variables, and then to validate the findings by applying the detected patterns to new subsets of data. The ultimate goal of data mining is prediction - and <u>predictive data mining</u> is the most common type of data mining and one that has the most direct business applications. The process of data mining consists of three stages: (1) the initial exploration, (2) model building or pattern identification with <u>validation/verification</u>, and (3) <u>deployment</u> (i.e., the application of the model to new data in order to generate predictions).

590 Image Processing and Computer Vision (3 cr.) Computer images are everywhere, occupying a dominant part of the computer culture. Three mail fields of computer imagery are computer graphics, image processing and computer vision. Computer vision techniques are used in computer graphics to collect and model complex scenes; computer graphics techniques are used constrain the recognition of 3D objects by computer; image processing techniques are routinely used by graphic designers to manipulate photographs. This course emphasizes image processing and computer vision, and their merging with many other applications. We will discuss image transform, feature detection and recognition in 2D image processing, and stereo, dynamic images, and 3D measure in computer vision.

590 Biometrics Computing (3 cr.) Biometrics is defined as the capture of the physiological and behavioral characteristics for personal identification and / or individual verification purposes. Since it uses individual personal characteristics to verify or recover identity, it is set to become a successor to the personal identification token. The technique of using biometric methods for identification can be widely applied to forensics, ATM banking, communication security, time and attendance, and access control. And it also plays an important role in enhancing homeland security. In this course we will introduce the principle of various biometric technology including face recognition, fingerprint identification, iris identification, voice recognition, DNA matching and the fundamental computational methods for implementation. Some of the topics include: authentication technologies, biometric systems, sensor and signal processing, face recognition, eye biometrics, fingerprint identification, and DNA matching.

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

A committee comprised of Dr. Mathew Palakal, Dr. Jeffrey Huang and Dr. Shiaofen Fang 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.

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
Email address: bukhres@cs.iupui.edu 317-274-8674
Personal Web Page: http://www.cs.iupui.edu/~bukhres
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**
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Personal Web Page: http://www.cs.iupui.edu/~ydai
Computing Systems Reliability, Software/Hardware Reliability, Grid Computing, Parallel/Distributed Computing, Fault Tolerant Computing, System Modeling are Dr. Dai's specialties.

Shiaofen Fang **X0329**
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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**
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Personal Web Page: http://www.cs.iupui.edu/~huang
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**
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Email address: mpalakal@cs.iupui.edu
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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.

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Xukai Zou **X0422**
Ph.D., Dec., 2000, Computer Science, University of Nebraska-Lincoln
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Applied cryptography and network security, Secure group communication: dynamic key, management, key agreement and distribution, Access control in distributed systems, Authentication and digital signature, data integrity and hash functions, Communication networks and wireless/mobile networks, Software engineering and Web/Internet technologies, Design and analysis of computer algorithms, Data/image processing compression.

Admissions requirements and procedures

General Admission Requirements for the Graduate Certificate in Cyber Security

Academic Standing

The applicant's record should exhibit outstanding achievement as indicated by the grade point average (GPA) for each degree over his or her entire academic record. An applicant is expected to have at least a 3.0 GPA on a scale of 4.

Core Background Requirements

All Graduate Certificate applicants should have a background in the following core areas of computer science:

· Data Structures and Algorithms.
· Theory (discrete math and theory of computation).

In addition, applicants should have a strong background in mathematics, including calculus, linear algebra, and in numerical computations. For students who do not have a degree in Computer Science or related field, CSCI 362 (Data Structures) or an equivalent course is required with a grade of B+ or better.

TOEFL Scores for International Students

All Graduate Certificate applicants whose native language is not English must submit a Test of English as a Foreign Language (TOEFL) score of at least 550 on paper based TOEFL and 250 on computer based TOEFL, or pass an equivalent test administered by IUPUI. These criteria are minimum requirements and the Department of Computer and Information Science may use additional criteria to make admission decisions. Potential applicants who have questions are advised to contact a Graduate advisor in the department.

Students admitted directly to the Computer Science Master of Science graduate program may earn this certificate in conjunction with their M.S. degree provided that all the requirements of the certificate program are satisfied.

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.

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

Database and Datamining 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 Databases/Datamining 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 Databases/Datamining. 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.

This program will introduce students to the core concepts necessary for the design, implementation, and application of database systems. It stresses the fundamental principles in database modeling and design. The aim is to address the continuing need for engineering databases for complex and ever changing applications requiring security, performance, and reliability. The teaching approach will be both instructional and researching. The program emphasizes fundamentals for the logical design of database systems, the entity-relationship model, semantic model, hierarchical model, network model implementations of the models, design theory for relational database, design of query languages and the use of semantics for query optimization, design and verification of integrity assertions and security, and introduction to intelligent query processing and database machines.

Data Mining is an analytic process designed to explore data (usually large amounts of data stored in a database - typically business or market related) in search of consistent patterns and/or systematic relationships between variables, and then to validate the findings by applying the detected patterns to new subsets of data. The ultimate goal of data mining is prediction - and predictive data mining is the most common type of data mining and one that has the most direct business applications. Through this program, students will have the understanding of initial data exploration methods, model building or pattern identification with validation/verification, and deployment (i.e., the application of the model to new data in order to generate predictions). Numerous datamining algorithms and tools will be introduced as well.

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. Yuni Xia, Assistant Professor, Department of Computer and Information Science will advise students.

Faculty initially involved in the program and their credentials

Omran Bukhres **X3801**
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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**
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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**
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Email address: sfang@cs.iupui.edu 317-274-9731
Personal Web Page: http://www.cs.iupui.edu/~sfang
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
Email address: huang@cs.iupui.edu 317-274-9746
Personal Web Page: http://www.cs.iupui.edu/~huang
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**
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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**
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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., Syracus University, 1994
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Personal Web Page: http://www.cs.iupui.edu/~rraje 317-274-5174
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**
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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.

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Dr. Zheng's research interests include Computer Vision, 3D Modeling, Dynamic Image Processing Image Processing, Multimedia, Internet, Scene Representation Graphics, Virtual Reality, Digital Museum Sensor Information Processing, Robotics

Xukai Zou **X0422**
Ph.D., Dec., 2000, Computer Science, University of Nebraska-Lincoln
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Web Page: http://www.cs.iupui.edu/~xkzou 317-278-8576
Applied cryptography and network security, Secure group communication: dynamic key, management, key agreement and distribution, Access control in distributed systems, Authentication and digital signature, data integrity and hash functions, Communication networks and wireless/mobile networks, Software engineering and Web/Internet technologies, Design and analysis of computer algorithms, Data/image processing compression.

Admissions requirements and procedures

General Admission Requirements for the Graduate Certificate in Database Datamining

Academic Standing

The applicant's record should exhibit outstanding achievement as indicated by the grade point average (GPA) for each degree over his or her entire academic record. An applicant is expected to have at least a 3.0 GPA on a scale of 4.

Core Background Requirements

All Graduate Certificate applicants should have a background in the following core areas of computer science:

- Data Structures and Algorithms.
- Theory (discrete math and theory of computation).

In addition, applicants should have a strong background in mathematics, including calculus, linear algebra, and in numerical computations. For students who do not have a degree in Computer Science or related field, CSCI 362 (Data Structures) or an equivalent course is required with a grade of B+ or better.

<u>TOEFL Scores for International Students</u>
All Graduate Certificate applicants whose native language is not English must submit a Test of English as a Foreign Language (TOEFL) score of at least 550 on paper based TOEFL and 250 on computer based TOEFL, or pass an equivalent test administered by IUPUI. These criteria are minimum requirements and the Department of Computer and Information Science may use additional criteria to make admission decisions. Potential applicants who have questions are advised to contact a Graduate advisor in the department.

Students admitted directly to the Computer Science Master of Science graduate program may earn this certificate in conjunction with their M.S. degree provided that all the requirements of the certificate program are satisfied.

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**
    1. Core: 503 (Operating Systems) or 580 (Algorithms)
    2. 541 (Databases)
    3. 590 (Data Mining)
    4. 590 (Distributed Databases)

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

503 Operating Systems (3 cr.) P: 403. Spring. Basic principles of operating systems: addressing modes, indexing, relative addressing, indirect addressing, stack maintenance; implementation of multitask systems; control and coordination of tasks, deadlocks, synchronization, mutual exclusion; storage management, segmentation, paging, virtual memory, protection, sharing, access control; file systems; resource management; evaluation and prediction of performance.

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.

541 Database Systems (3 cr.) P: 443 or equivalent. Spring. Fundamentals for the logical design of database systems. The entity-relationship model, semantic model, relational model, hierarchical model, network model. Implementations of the models. Design theory for relational databases. Design of query languages and the use of semantics for query optimization. Design and verification of integrity assertions, and security. Introduction to intelligent query processing and database machines.

590 Data Mining (3 cr.) *Data Mining* is an analytic process designed to explore data (usually large amounts of data - typically business or market related) in search of consistent patterns and/or systematic relationships between variables, and then to validate the findings by applying the detected patterns to new subsets of data. The ultimate goal of data mining is prediction - and predictive data mining is the most common type of data mining and one that has the most direct business applications. The process of data mining consists of three stages: (1) the initial exploration, (2) model building or pattern identification with validation/verification, and (3) deployment (i.e., the application of the model to new data in order to generate predictions).

590 Distributed Databases (3 cr.) Fundamental issues in distributed database systems that are motivated by the computer networking and distribution of processors and databases. The theory, design, specification, implementation, and performance of distributed database systems.

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

A committee comprised of Dr. Mathew Palakal, Dr. Yuni Xia and Dr. Snehasis Mukhopadhyay 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.

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

Software Engineering 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 Software Engineering 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 Software Engineering. 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.

A central problem of today's economical development and competitiveness in industry, society, science and engineering is the mastering of complex, large, heterogeneous, software-intensive products and the processes of their construction, application and adaptation. The success of software products and services as well as of enterprises and organizations is increasingly determined by the availability of such adequate software solutions.

Software engineering is the establishment and use of engineering principles to manage the human and technical components involved in creating software so that it satisfies the client's functional requirements and constraints. This program is intended as an introduction to the principles and practice of software engineering. It will cover tools and techniques used in software development to evaluate and control software quality and project progress.

Topics include life cycle concepts, applied to program specification, development and maintenance, the use of a specific methodology in developing large programs, program verification, and techniques for testing and quality control. The goal is to acquire an understanding of the principles of, and skills in current practice for, carrying out a team sized software engineering projects. Students completing this certificate will be familiar with esthetic issues in software design, ethical practices in the software industry, current process for developing software, current process for managing software engineering projects, measures of software quality, measures of project progress, tools that support software engineering projects.

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. Rajeev Raje, Associate 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
Email address: bukhres@cs.iupui.edu 317-274-8674
Personal Web Page: http://www.cs.iupui.edu/~bukhres
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
Email address: ydai@cs.iupui.edu 317-274-3473
Personal Web Page: http://www.cs.iupui.edu/~ydai
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
Email address: sfang@cs.iupui.edu 317-274-9731
Personal Web Page: http://www.cs.iupui.edu/~sfang
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
Email address: huang@cs.iupui.edu 317-274-9746
Personal Web Page: http://www.cs.iupui.edu/~huang
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
Email address: mpalakal@cs.iupui.edu
Personal Web Page: http://www.cs.iupui.edu/~mpalakal 317-274-9735
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., Syracus University, 1994
Email address: rraje@cs.iupui.edu
Personal Web Page: http://www.cs.iupui.edu/~rraje 317-274-5174
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
Email address: tuceryan@acm.org
Web Page: http://www.cs.iupui.edu/~tuceryan 317-274-9736
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.

Jiang Yu Zheng **X0384**
Ph.D., Osaka University, 1990
Email address: jzheng@cs.iupui.edu
Web Page: http://www.cs.iupui.edu/~jzheng 317-274-9742
Dr. Zheng's research interests include Computer Vision, 3D Modeling, Dynamic Image Processing Image Processing, Multimedia, Internet, Scene Representation Graphics, Virtual Reality, Digital Museum Sensor Information Processing, Robotics

Xukai Zou **X0422**
Ph.D., Dec., 2000, Computer Science, University of Nebraska-Lincoln
Email address: xkzou@cs.iupui.edu
Web Page: http://www.cs.iupui.edu/~xkzou 317-278-8576
Applied cryptography and network security, Secure group communication: dynamic key, management, key agreement and distribution, Access control in distributed systems, Authentication and digital signature, data integrity and hash functions, Communication networks and wireless/mobile networks, Software engineering and Web/Internet technologies, Design and analysis of computer algorithms, Data/image processing compression.

Admissions requirements and procedures

General Admission Requirements for the Graduate Certificate in Software Engineering

Academic Standing

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Core Background Requirements

All Graduate Certificate applicants should have a background in the following core areas of computer science:

- Data Structures and Algorithms.
- Theory (discrete math and theory of computation).

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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**
  1. Core: 565 (Programming Languages)
  2. 506 (Management of Software Development Process)
  3. 507 (Object Oriented Design and Programming)
  4. 537 (Distributed Computing) or 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.

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Course lists for the program including course descriptions

506 Management of the Software Development Process (3 cr.) A survey of the fundamental principles and concepts of managing a software project. Topics include life cycle models, standards and goals, cost estimation, risk analysis, tool use, component reuse, traceability, metrics, and process control and improvement. Students are required to apply management concepts using a project-based approach.

507 Object-Oriented Design and Programming (3 cr.) An advanced exploration of the object-oriented model and programming. Topics range from a review of the object model to advanced concepts such as abstraction mechanisms, standard library/packages, OO design using an OO language, the syntax and the semantics of constructs.

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.

537 Introduction to Distributed Computing (3 cr.) P: 503 and 536. Introduction to the principles and methods in the design of distributed computing systems. It covers the fundamentals of distributed computing from four perspectives: underlying communication media, protocols and their implications; operating system issues; high-level language constructs; and distributed algorithms.

565 Programming Languages (3 cr.) P: 300. R: 470. Fall. An exploration of modern or unconventional concepts of programming languages, their semantics, and their implementations; abstract data types; axiomatic semantics using Hoare's logic and Dijkstra's predicate transformers; denotational semantics; functional, object-oriented, and logic programming; concurrency and Owicki-Gries theory. Example languages include ML, Ada, Oberon, LISP, PROLOG, and CSP.

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

A committee comprised of Dr. Mathew Palakal, Dr. Rajeev Raje 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

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