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

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 Biometrics 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 Biometrics. 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.

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.

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. 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**
Ph.D. in Computer Science, National University of Singapore, September 2003
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Computing Systems Reliability, Software/Hardware Reliability, Grid Computing, Parallel/Distributed Computing, Fault Tolerant Computing, System Modeling are Dr. Dai's specialties.

Shiaofen Fang **X0329**
Ph.D., University of Utah, 1992
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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
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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**
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
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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.

Jiang Yu Zheng **X0384**
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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 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 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 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.