UNIVERSITY OF Miami
FACULTY SENATE

# MEMORANDUM

**To:** Donna E. Shalala
President

**From:** Stephen Sapp
Chair, Faculty Senate

**Date:** March 31, 2008

**Subject:** Faculty Senate Legislation #2007-40(B) – College of Arts and Science Establishment of a Doctor of Philosophy (PhD) in Computer Science

**********

The Faculty Senate, at its March 26, 2008 meeting, voted unanimously to approve the College of Arts and Science establishment of a Doctor of Philosophy in Computer Science.

The proposal is enclosed for your reference.

This legislation is now forwarded to you for your action.

SS/rh

Enclosure

cc: Thomas LeBlanc, Executive Vice President and Provost
✓David J. Birnbach, Vice Provost for University Administration and Faculty Affairs
✓Michael Halleran, Dean, College Arts and Science
✓Teresa Scandura, Dean, Graduate School
✓Huseyin Kocak, Proposal presenter, Professor, Department of Computer Science

[Please contact the Senate office to view this proposal.]

Faculty Senate
1252 Memorial Drive, 325 Ashe Admin. Bldg.
Coral Gables, Florida 33124
Phone: (305) 284-3721 • Fax: (305) 284-5515
http://www.miami.edu/FacultySenate
email: facsen@miami.edu

Faculty Senate Legislation #2007-39(B) – College of Arts and Science establishment of a Doctor of Philosophy in Computer Science

## PRESIDENT'S RESPONSE

APPROVED: _____ DATE: 4/7/08
(President's Signature)

OFFICE OR INDIVIDUAL TO IMPLEMENT: DEAN MICHAEL HALLERAN

EFFECTIVE DATE OF LEGISLATION: _____
(if other than June 1 next following)

NOT APPROVED AND REFERRED TO: _____

REMARKS (IF NOT APPROVED): _____

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REMARKS (IF NOT APPROVED): _____

# FACULTY SENATE MEETING AGENDA
## BankUnited Center, Hurricane 100 Room
## March 26, 2008 – 3:30 p.m.

For all items except B4 CLICK HERE
For Item B4 CLICK HERE

| | | | Approx. Time |
|---|---|---|---|
| **A.** | | **Introductory Matters** | |
| | A1. | # Chair's remarks | 3:30 |
| | A2. | President's remarks | 3:35 |
| | A3. | Approval of today's agenda | 4:00 |
| | A4. | # Approval of minutes of February 27, 2008 | 4:05 |
| | A5. | Other announcements | 4:10 |
| **B.** | | **General Matters** | |
| | B1. | Introduction of Sheri A. Keitz, M.D., Ph.D., Associate dean for Faculty Diversity and Development, Miller School of Medicine, Chief, Medical Service, Miami VA Healthcare System – S. Hayes | 4:15 |
| | B2. | * Miami Institute for Human Genomics and Component Center Proposals – J. McCafferty-Cepero | 4:30 |
| | B3. | * Proposal for a Doctor of Philosophy in Computer Science – H. Kocak | 4:45 |
| | B4. | * Proposal for a New Degree Program, the Master in Real Estate Development and Urbanism (MRED&U) – E. Plater-Zyberk, C. Bohl | 5:10 |
| | B5. | * Academic Standards Committee Undergraduate Admission Report – S. Cantrell | 5:35 |
| | B6. | # Move of Master of Public Administration from the School of Business Administration to the College of Arts and Sciences – S. Hayes | 6:00 |
| | B7. | # Senate Apportionment – S. Hayes | 6:05 |
| | B8. | Election of Nominating Committee – S. Hayes | 6:15 |
| **C.** | | **Other Business** | |
| **D.** | | **Executive Session** | |
| | D1. | Selection of the Outstanding Teaching Award recipient | 6:20 |
| **E.** | | **Adjournment** | |

# related material
* These materials are not for public viewing and will not be posted on the Faculty Senate website.

# A Proposal for a New Degree Program
# Doctor of Philosophy in Computer Science

Unanimously Approved by College of Arts and Science, November 16, 2004

Unanimously approved by the Graduate Council, October 27, 2007

Revised: March 22, 2008 *

Department of Computer Science
College of Arts and Sciences
University of Miami

*Clarifications have been made at the request of the Faculty Senate General Welfare Committee. No changes have been made to requirements of program.

# Contents

# 1 Introduction

## 1.1 The Field of Computer Science

Computer science is the systematic study of computation. The fundamental building blocks of the field are algorithms, the descriptions of computational processes in terms of well-defined instructions. Algorithms capture underlying ideas behind computation and enable conversations among scientists without having to use specific programming languages. While the concept of algorithms has existed for more than two millennia, it is only in the later part of the last century that the first academic computer science departments were created. Despite its infancy, however, the field of computer science has grown at a remarkable speed and has now acquired a prominent position in academic institutions, both in the states and in other modern countries. The growth is in part due to the rapid advancements in computer technologies, as observed in the so-called Moore's law, which states that the density of transistors on computer chips doubles every eighteen months. However, what truly propelled the growth are the ingenious concepts and earth-shaking algorithms produced by computer scientists, which have made computing more interesting, more effective, and more accessible. Such ideas include computer graphics, email, object-oriented programming, public-key cryptography, sorting, string matching, virtual reality, and world-wide web. The influence of those revolutionary ideas have gone very far beyond the boundary of computer science. Computing has become not only a central tool for many fields of natural sciences, engineering, social sciences, business, medicine and arts but an essential part of human life. This unprecedented ubiquity puts computer science in a very unique position in academe and makes it one of the most important, if not the most important, disciplines of the 21st century.

Critical missions of any scholastic discipline are research and education, and in many disciplines the two missions are intricately related with each other. This is certainly the case for computer science. In most research areas of computer science, investigations are through experimentation involving complex computer programs. Academic computer scientists can therefore speed up substantially their research investigations by teaming up with graduate students that understand and implement underlying scientific ideas. This partnership between the advisers and the advisees are mutually beneficial. While the gain of speed allows the researchers to produce more results, the graduate students receive critical training through hands-on research experience. Since even the most advanced computing technologies of today may be become outdated tomorrow, graduate computer science training must instill in students universal research skills that stand the test of time.

## 1.2 The UM Computer Science Department

At the University of Miami, the Computer Science Department was created in 2000 out of the Mathematics Department, in part for the purpose of serving the growing demands of the UM undergraduate students to receive education in the field. The research expertise of the current Computer

Science tenure-track faculty touches upon a variety of key research areas: artificial intelligence, automated reasoning, bioinformatics, computational complexity, computational geometry, computer graphics, cryptography and security, data mining, large-scale modeling, molecular computation, multimedia systems, and network algorithms. The department currently has eight tenure-track faculty members (seven of them are tenured). The existing tenure-track faculty members received graduate training in the areas that have a strong focus on algorithms, i.e., the abstract ideas underlying computation. This makes them ideal for teaching students how to think creatively using standard methodologies as well as how to transfer ideas from one subject to another. The proximity of the Department to researchers in the University whose work heavily uses computation (those in the Departments of Biology, Chemistry, and Physics on the Coral Gables Campus and those in the Schools of Marine and Atmospheric Sciences and of Medicine) offers tremendous advantage for these researchers to engage in interdisciplinary collaboration with members of the Department. In fact, the Computer Science Department has a proven record of exploring such opportunities to produce excellent research outcomes, and of training students through such projects. The Department takes its pride in having sent both of its undergraduate and graduate students to top jobs, both in the mainstream computer science field and in interdisciplinary fields, such as bioinformatics.

The interdisciplinary research of the Department is expected to be strengthened further through its involvement with the recently created Center for Computational Sciences. The Center is expected to offer five core research programs, each led by a director having a tenure-track primary appointment. So far only one core program director has been recruited, and that director is primarily appointed in Computer Science. The rest of the program directors will be recruited in the next two years, and one or two of them are likely also to have appointments in Computer Science. Also, it is anticipated that many of the in-house Ph.D. researchers of the Center, who directly report to program directors, will have formal affiliations with the Department. The affiliation of the directors and the researchers gives a tremendous opportunity for the Department to extend its research horizon and widen its educational programs. The Department believes that by capitalizing this unique opportunity it will be able to boost its external research funding substantially, produce more high quality research, and enrich its educational programs, and thereby increase its visibility both within the University and in the national and international computing research communities.

## 1.3 The Purpose of This Document

Establishing a Ph.D. program will greatly speed up the research progress and make the Department significantly more productive and more visible. The Department hereby requests approval to establish such a program, with the goal of enrolling the first batch of students in the academic year of 2008-09.

The requested Ph.D. leverages the existing mature Master of Science program in Computer Science, which the Department inherited from the Mathematics program and which has been graduating

students since 1971. Since 1996, the Master of Science program has graduated 54 students[1]. The classroom courses taught for the Master of Science program (and in the Computer Engineering program) are sufficient for starting a Doctor of Philosophy program in Computer Science of minimum breadth. (See the table of Computer Science courses taught from 1994 to 2007 in Section 7.)

### 1.4 Outline of the Rest of the Document

Section 2 discusses the expected outcomes of the requested Ph.D. program. Section 3 provides the description of the new program, which closely follows the Ph.D. curriculum in computer science at several prominent universities. Section 3.5 presents the current categorized list of approved graduate-level courses. Section 4 describes the resources available to the students of the new program. Section 5 gives a short description of each graduate faculty member in the Department of Computer Science. Section 6 provides the text that should be added to the graduate bulletin. Section 7 answers some common questions about the proposal. Section 8 gives additional supporting material. Curriculum Vitae are attached.

## 2 Expected Outcomes

### 2.1 Interdisciplinary Ph.D. Programs

The March 2001 issue of the SIAM Review contains an article describing an influential program that mixes a graduate Computer Science curriculum with other science and engineering-oriented curricula. The article states, "Computational science and engineering (CSE) is a rapidly growing multidisciplinary area with connections to the sciences, engineering, mathematics, and computer science." The influence of Computer Science is strong in such fields as biology, chemistry, physics, medicine, and bioengineering. Many universities across the country have already established such interdisciplinary programs, in particular, establishing interdisciplinary programs in computational biology/bioinformatics has been a trend in the past few years. For example, the CSE Program at Purdue University "offers [MS and Ph.D.] specializations in computational science and computational engineering in 17 departments..." Although such an interdisciplinary program is certainly worth pursuing, before the University can create such a program it must have as a basis to cover the fundamentals, including a strong Ph.D. program in Computer Science.

### 2.2 Undergraduate and Graduate Relationships

Graduate teaching assistants, who currently are master's students, run course labs (for courses with a lab in addition to a lecture), grade homework, and monitor the teaching lab during non-class daytime hours, nights, and weekends, when the undergraduates work on their programming

[1] See Section 8

assignments. Since Ph.D. students will remain in the Department longer than master's students, they will have more time to gain research and teaching experience. This teaching experience will directly benefit the undergraduate Computer Science program and the undergraduate students in the University. For example, a Ph.D. student will have the opportunity to assist a greater variety of courses and thus is more likely to be able to answer a question posed by an undergraduate when the Ph.D. student is monitoring the teaching lab.

In addition to enhancing the current duties of teaching assistants, Ph.D. students will serve two new roles. First, Ph.D. students will help bridge faculty research to undergraduates. Second, Ph.D. students act as role models for undergraduates. Their influence will motivate talented undergraduates to pursue research and enter Ph.D. programs. Successful researchers generally remember their undergraduate years and the influence it had on their decision to pursue post-graduate studies.

One might think that a Ph.D. program would shift faculty time away from the undergraduate program, but quite the opposite is true: the *lack* of a Ph.D. program steals time from the undergraduate program. Given the universality of Ph.D. programs at research institutions, the Department faculty are expected to have a certain level of productivity in order to obtain grants and promotions. With a master's student, a faculty member has to spend much time and effort getting the student up to speed only to generate perhaps one joint paper. A Ph.D. student requires hardly more effort and leads to a much longer and more fruitful collaboration. The lack of a Ph.D. program means that faculty have to take time away from undergraduates in order to train graduate students.

## 2.3 Job Market Prospects

Computer Science graduates earn some of the highest salaries among all college-level graduates. The benefits of a Computer Science degree for an undergraduate are well understood. Having a Ph.D. in Computer Science presents further benefits. The tremendous amount of resources being devoted to information sciences ensures that a Ph.D. in Computer Science will remain a major asset for many years. Upon graduation, a Ph.D. student can expect to find numerous research jobs in both academia and industry.

According to the 2005-2006 Taulbee Survey, Table 4, 26.0% of Ph.D. recipients find employment in North American Ph.D.-granting departments: 12.8% tenure-track, 2.6% researcher, 8.9% postdoc, and 1.7% teaching faculty. 5.2% find positions in other CS/CE departments. 49.4% find jobs in industry and 2.6% in government. Only 0.7% were unemployed. According to Table 27, the mean and median salary for NTT faculty was above $62,000. The mean and median salary for assistant professors was above $84,000. According to the 2002 Industrial Salary Survey of CS Research Labs (the latest available), the mean and median salary for a new Ph.D. was above $99,000.

Clearly, the demand for qualified researchers in Computer Science is high, and the prospects of a Ph.D. graduate in Computer Science are good.

# 3 Description

## 3.1 Exact Title of Degree

DOCTOR OF PHILOSOPHY IN COMPUTER SCIENCE

## 3.2 Overview

To earn a Ph.D. in Computer Science, a student must satisfy all the general requirements for a Ph.D. set by the graduate school: standardized tests, grade point average, residency, minimum credit distributions, *etc.* The following requirements are those which are specific to the Computer Science program. The goal of this program is to provide the Ph.D. student with both overall *breadth* in the field and *depth* in a particular area of concentration. To that end, the curriculum is broken into several categories:

- **A written qualifying examination** demonstrating advanced general knowledge (breadth) in Computer Science.
- **Course requirements** covering material in many areas, strengthening breadth, and extra course work in one particular area, strengthening depth.
- **Two research projects** building depth of knowledge in a particular field, as well as strengthening relationships between faculty and students for possible dissertation work.
- **Thesis proposal and defense,** accompanied by an oral exam to demonstrate significant depth in the chosen field.
- **Annual presentations** to demonstrate depth of knowledge, strengthen presentation skills, and provide a means of overseeing the student's progress.
- **Teaching experience** to strengthen both the student's presentation skills and the ability to explain materials in a coherent manner.

A Ph.D. student successfully completing the requirements in all of these categories will have demonstrated significant knowledge and understanding of the field of Computer Science and shall be deemed ready to use that knowledge in the broader community.

## 3.3 Admission Requirements

In order to be admitted to the Ph.D. program in Computer Science, an applicant must meet all of the requirements set by the Graduate School including adequate scores on the GREs. In addition, a minimum of 15 credits in Computer Science courses at sophomore level and above is required. These courses in the computer science department at UM are numbered 200 and above. Students may be admitted with deficiencies; these must be completed in addition to the degree requirements.

## 3.4 Ph.D. Degree Requirements

Upon completion of the curriculum, the student will have earned at least 60 credit hours beyond that of a bachelor's degree. Minimally, 12 credits will have come from dissertation research, 6 credits from research projects, and 24 credits from classroom courses. However, a typical student will have earned 24 credits from dissertation research, 12 credits from research projects, and 24 credits from classroom courses. At least 30 credits must be open only to graduate students. These courses at UM are numbered 600 and above. The student must also have obtained a minimum of 24 credits while in residence at UM. The Computer Science Graduate Committee (CSGC) maintains full authority over all decisions pertaining to a Ph.D. student. In particular, the acceptance of credits transferred by the student from another post-graduate institution shall be determined by the CSGC.

As specified by the Graduate School, degree requirements must be completed within eight years of the time of admission to graduate work and within four years of passing the qualifying examination. A Computer Science Ph.D. student shall be deemed to have passed the qualifying examination process upon completion of the written qualification examination and the research project requirements.

What follows is a more in-depth description of the categories, detailing the various criteria the student is expected to meet.

### Written Qualifying Exam

Every Ph.D. student must pass a three hour written exam of general knowledge of Computer Science at the end of the first year. Upon failure, the student may petition the CSGC to allow a second attempt at the end of the second year.

The exam will be administered once a year in the early weeks of the summer session. It will cover expected knowledge of all first-year graduate students. Included in this material are a fundamental understanding of algorithm analysis and design, advanced skills in programming, basic knowledge of computer architecture, and a general understanding of computer systems.

### Classroom Course Requirements

In the first two years, the student must take eight CSGC-approved classroom courses, for a total of 24 credits. At least four of these courses (12 credits) must be open only to graduate students. These courses at UM are numbered 600 and above.

The eight courses must include two courses from each of the areas of Analysis, Applications, and Systems. The student should work with his or her advisor to select a cohesive set of courses as approved by the CSGC.

The CSGC will have sole authority in designating the areas to which each course belongs. In the case that a course is designated in more than one area, a student may apply the course to only one area. The designation of current CSGC-approved courses appears in Section 3.5.

### Project Course Requirements

By the end of the second year the student must complete two graduate level project courses for a minimum total of 6 credits. Each project shall be under the supervision of a *different* faculty member in the Department.

All Ph.D. students must find faculty willing to supervise their project in the semester preceding the project. The deadline for finding a supervisor shall be the first full week in April or November for the Fall and Spring terms, respectively. This deadline does not require identifying a specific project but only finding a faculty member willing to supervise a project.

Upon completion of a project, the student must write a detailed project report. This report shall become a public document and shall be kept on file by the Department. The student must present the finished project to a quorum of the CSGC at a time to be approved by the chairman of the Department. The supervisor and CSGC must approve each project as applicable toward candidacy for a Ph.D. A primary factor in determining approval shall be the stated willingness of the supervisor to become an initial Ph.D. advisor for the student.

### Dissertation Committee, Proposal, and Defense

Upon completion of the two projects, the CSGC shall appoint a Dissertation Committee for the student as required by the Graduate School. The student must present a thesis proposal by the end of the fourth year. Both proposal and defense will include a public oral presentation followed by questioning from the Dissertation Committee.

### Development of Presentation Skills

After passing the written qualifying exam, the student must make a public oral presentation to the Department at least once per year. These presentations include the two project presentations, the thesis proposal, and the thesis defense. The goals are to develop the student's oral and presentation skills, to provide a means for the Department to check the research and progress of the student, and to present the opportunity for feedback to improve the student's research.

### Teaching Experience

Since Ph.D. graduates should be qualified to work in academia, each student must teach a lab-based course for a minimum of one semester. Lab-based courses introduce the student to working

closely with both a faculty member and undergraduate students. These courses typically require the student to present material in a relaxed lecture format, re-emphasizing material learned in the general lecture as well as introducing new material to the students.

## 3.5 Approved Course Categories

The following is a list of approved courses for the classroom course requirements:

### Analysis

| | | | |
|---|---|---|---|
| CSC 506 | Logic | CSC 612 | Theory of Complexity |
| CSC 517 | Data Structures and Algorithm Analysis | CSC 623 | Theory of Relational Databases |
| CSC 518 | Compiler Theory | CSC 628 | Parallel Algorithms |
| CSC 519 | Programming Languages | CSC 646 | Neural Computing |
| CSC 527 | Theory of Computing | CSC 647 | Computational Geometry |
| CSC 531 | Introduction to Software Engineering | EEN 634 | Modeling and Analysis of Computer Networks |
| CSC 540 | Algorithm Design and Analysis | EEN 656 | Information Theory |
| CSC 545 | Introduction to Artificial Intelligence | MTH 509 | Discrete Mathematics II |
| CSC 606 | Logic Programming | MTH 520 | Numerical Analysis I |
| CSC 609 | Cryptography and Data Security | MTH 521 | Numerical Analysis II |
| CSC 611 | Theory of Computation | MTH 528 | Combinatorics |

### Applications

| | | | |
|---|---|---|---|
| CSC 523 | Principles of Filing and Database Systems | CSC 648 | Automated Reasoning |
| CSC 529 | Introduction to Computer Graphics | CSC 655 | Advanced Multimedia Systems |
| CSC 545 | Introduction to Artificial Intelligence | EEN 577 | Data Mining |
| CSC 555 | Multimedia Systems | EEN 638 | Computer Vision |
| CSC 628 | Parallel Algorithms | EEN 653 | Pattern Recognition and Neural Networks |
| CSC 645 | Expert System Design | MTH 520 | Numerical Analysis I |
| CSC 646 | Neural Computing | MTH 521 | Numerical Analysis II |

### Systems

| | | | |
|---|---|---|---|
| CSC 518 | Compiler Theory | CSC 645 | Expert System Design |
| CSC 519 | Programming Languages | CSC 655 | Advanced Multimedia Systems |
| CSC 521 | Principles of Computer Operating Systems | EEN 514 | Computer Architecture |
| CSC 523 | Principles of Filing and Database Systems | EEN 534 | Computer Communication Networks |
| CSC 524 | Networks and Information Security | EEN 614 | Advanced Computer Architecture |
| CSC 555 | Multimedia Systems | EEN 634 | Modeling and Analysis of Computer Networks |
| CSC 609 | Cryptography and Data Security | EEN 671 | Advanced Interactive Multimedia Information Systems |

## 3.6 Projected Program Size

Here is a conservative projected graduate program size. We plan to accept two Ph.D. students per year to reach a total of 10 students.

| year | 1st | 2nd | 3rd | 4th | 5th |
|---|---|---|---|---|---|
| M.S. | 16 | 15 | 14 | 13 | 12 |
| Ph.D. | 2 | 4 | 6 | 8 | 10 |
| Total | 18 | 19 | 20 | 21 | 22 |

As resources are diverted from the master's program to the Ph.D. program, the number of master's students may decrease, but the total number of graduate students will increase.

# 4 Resources

The Department of Computer Science already has the resources to support the research of its faculty, its Master of Science program, and a Ph.D. program.

## 4.1 Teaching Assistantships

The Department has an allocation of seven teaching assistantships. Interdisciplinary Ph.D. students currently associated with the Department are also supported by individual faculty research funds, the university fellowship program, and the McKnight Fellowship program. Given the diversity of funding available for graduate students in Computer Science, no additional allocation of teaching assistantships is required.

## 4.2 Current Funding

Huseyin Kocak, Burt Rosenberg, Brian Coomes (Mathematics), $299,000, NSF.
Huseyin Kocak, RSMAS (F. Beron-Vera, M. Brown, M. Olascoaga), $900,000, NSF.
Victor Milenkovic, $240,000, NSF.
Dilip Sarkar, $27,650, University of Miami Small Grant.
Geoff Sutcliffe, $20000, Unrestricted gift to the University of Miami in support of Research in Automated Reasoning, Articulate Software.
Geoff Sutcliffe (PI), Huseyin Kocak (co-PI), Burt Rosenberg (co-PI), Victor Pestien (co-PI) (Mathematics), $467575, Computer Science and Mathematics for Scientists, NSF Scholarships in Science, Technology, Engineering, and Mathematics.
Geoff Sutcliffe, $1500, Unrestricted gift to the University of Miami in support of the CADE-21 Workshop on Empirically Successful Automated Reasoning in Large Theories, Microsoft Research.
Geoff Sutcliffe (host), Josef Urban (researcher), Euro 176076, Automating Reasoning in Large Formal Mathematical Knowledge Bases, European Union Marie Curie Outgoing International Fellowship.

Please see Curriculum Vitae for details.

## 4.3 External Funding

Having Ph.D. students and obtaining external funding are corequisites. We expect both to increase as the Department grows. According to Table 24-2 from the 2004-2005 and 2005-2006 Taulbee Survey, mean expenditure from external sources per tenure-track faculty is above $100,000 per year even for universities ranked below the top 36. The lion's share of this money goes to support Ph.D. students.

**NOTE:** The program is *not* dependent on external funding to get started. With seven teaching assistantships available, we can afford to provide each faculty member with a Ph.D. student to work with. This is enough for a good faculty member to "bootstrap" to an externally funded research program.

## 4.4 Funding Mix

Table 25 of the 2005-2006 Taulbee survey (http://www.cra.org/CRN/articles/may07/tables24to26.html) indicates the following for US departments ranked higher than 36th. 54.5% of student funding comes from institutional support, with 36.2% being teaching assistantships. It follows that our initial goal of roughly half the students on teaching assistantships and half on external funding is not out of line and will not unduly hamper recruitment of good students in comparison to peer universities.

Table 42 of the 2005-2006 Taulbee survey (http://www.cra.org/CRN/articles/may07/tables39to44.html) gives external funding sources for departments ranked higher than 36th. The NSF provides 45.7% with defense a distant second. The bulk of our current funding comes from the NSF or the equivalent European agency. A small part comes from industry, but it is significant because it is much more flexible. Again, we are not out of line with similar universities, although we need to increase funding from other sources. We have a significant joint NSF project with RSMAS. With our focus on bioinformatics, we can hope for participation in an NIH project in the Medical school. Defense funding will be difficult to obtain until we are much larger.

## 4.5 Equipment

The College of Arts and Sciences recently committed resources to a significant equipment upgrade:

- One classroom lab with 20 UNIX workstations, instructor's workstation, projector, and screen.
- One research/learning lab with 6 UNIX Workstations and 6 Windows PCs.
- Machine room housing servers and network equipment for the labs, faculty email, and the departmental web page and a firewall.

- Desktop PC, bootable in UNIX or Windows, for each teaching assistant.
- Computational cluster with 12 processors and 2 servers.

In addition to the general labs available to students, the Department already has an equipped lab with several machines and accessories for multimedia research and development.

The Department provides a desktop computer to each fellowship recipient.

## 4.6 Information Resources

The Department has sufficient access to resources through the University's Richter Library and online resources. The library's holdings are also expected to expand as new faculty with new areas of interest join the Department. The Department has an additional $7,000 annual budget with the library to purchase any materials not automatically acquired by the library.

In addition, many relevant journals and other resources are easily available online through the library's online subscriptions to publishers such as IEEE and the ACM digital library. This is extremely important in the Computer Science field, as most current research is being made available online quicker and more cost effectively than in printed format.

Section 4.7 lists the current Computer Science journal holdings at the library.

## 4.7 Journal Title Holdings

The following is a list of the current journal title holdings for Computer Science at the University of Miami's Richter Library:

A & I and Society
ACM Journal of Computer Documentation
ACM Letters on Programming Languages and Systems
ACM Sigplan Notices
ACM Transactions on Computational Logic
ACM Transactions on Computer Systems
ACM Transactions on Database Systems
ACM Transactions on Human Computer Interaction
ACM Transactions on Mathematical Software
ACM Transactions on Modeling and Computer Simulation
ACM Transactions on Programming Languages and Systems
ACM Transactions on Software Engineering and Methodology
Acta Informatica
AI Magazine
Algorithmica
Annals of Mathematics and AI
Applied Mathematics and Computation
Artificial Intelligence
BIT
BYTE
Combinatorics, Probability and Computing
Communications of the ACM
Computational Complexity
Computational Intelligence
Computer
Computer Aided Geometric Design
Computer Architecture News
Computer Communication
Computer Design
Computer Journal
Computer Languages
Computers and Mathematics with Applications
Computers and Security
Computing
Cybernetics
Database Programming
Distributed Computing
Expert Systems
Formal Aspects of Computing
Fundamenta Informaticae
Future Generation Computer Systems
Fuzzy Sets and Systems
IEEE Concurrency
IEEE Internet Computing
IEEE Micro - Chips, Systems, Software and Applications
IEEE Multimedia
IEEE Software
IEEE Transactions on Multimedia
IEEE Transactions of Information Theory
IEEE Transactions on Evolutionary Computation
IEEE Transactions on Fuzzy Systems
IEEE Transactions on Knowledge and Data Engineering
IEEE Transactions on Neural Networks
IEEE Transactions on Parallel and Distributed Systems

IEEE Transactions on Pattern Analysis and Machine Intelligence
IEEE Transactions on Software Engineering
IEEE Transactions on Systems, Man and Cybernetics ; Part A and B
Information and Computation
Information Processing Letters
Information Systems Research
Interacting With Computers
International Journal of Computational Geometry and Applications
International Journal of Foundations of Computer Science
International Journal of Human Computer Interaction
International Journal of Parallel Programming
International Journal of Systems Science
Journal of Algorithms
Journal of Automated Reasoning
Journal of Computation and Applied Mathematics
Journal of Computational Analysis
Journal of Computer and System Sciences
Journal of Computer Information Systems
Journal of Cryptology
Journal of Database Management
Journal of End-User Computing
Journal of Functional Programming
Journal of Logic and Computation
Journal of Logic Programming
Journal of Network and Computer Applications
Journal of Object Oriented Programming
Journal of Parallel and Distributed Computing
Journal of Scientific Computing
Journal of System Architecture
Journal of Systems and Software
Journal of Systems Architecture
Journal of the ACM
Journal of Visual Languages and Computing
Knowledge and Information Systems
Knowledge Based Systems
Linux Journal
Mathematical and Computer Modeling
Mathematical Programming
Mathematical Structures in Computer Science
Mathematics and Computer Education
Mathematics and Computers in Simulation
Mathematics of Computation
Microcomputer Applications
Multimedia Systems
Network: Computation in Neural Systems
Neural Computing and Applications
Neural Networks
Parallel Computing
Parallel Processing Letters
Pattern Recognition
Problems of Information Transmission
Programming and Computer Software
Random Structures and Algorithms
SIAM Journal on Computing
SIAM Journal on Scientific Computing
SIGMOD Record
Soft Computing
Software Concepts and Tools
Software Engineering Notes
Software Practice and Experience
Software Testing, Verification and Reliability
Systems and Control Letters
Theoretical Computer Science
Unix Review
Virtual Reality
Visual Computer
VLDB International Journal on Very Large Databases

# 5 Graduate Faculty

## Dr. Huseyin Kocak, Professor and Chairman

Ph.D. in Mathematics, 1980, University of California at Santa Cruz.

**Research Interests:** Dynamical Systems and their applications to biology, ecology and medicine; Scientific Computing, Visualization.

**Students:** Huseyin has advised and/or served on the committees of several dozen Master's and Doctoral students from The College of Arts and Sciences, School of Engineering, School of Atmospheric and Marine Sciences, and the former School of International Studies. He graduated an interdepartmental Ph.D. student, McKnight Fellow Morgan Johnson (2006). Currently, he is advising the Master's Thesis of Craig Kolthoff of the IT department.

## Dr. Thomas LeBlanc, Professor Executive Vice President and Provost

Thomas J. LeBlanc, executive vice president and provost, was appointed in 2005. He is the chief academic officer and chief budget officer for the University and is responsible for overseeing and coordinating academic programs and enhancing the educational mission of the University. He is also a professor in the Departments of Computer Science and Electrical and Computer Engineering. Previously, LeBlanc served as dean of the college faculty in the College of

Arts, Sciences, and Engineering at the University of Rochester. His publications include writings on operating systems, parallel programming, and software engineering. He holds a Ph.D. and a master's degree in Computer Science from the University of Wisconsin at Madison and a Bachelor of Science in Computer Science from State University of New York at Plattsburgh [http://www6.miami.edu/UMH/CDA/UMH_Main/0,1770,2472-1;46573-3,00.html].

### Dr. Victor Milenkovic, Professor

Ph.D., 1988, Carnegie Mellon University.
**Research Interests:** Computational Geometry, Layout, Graphics, Numerical Issues, Computational Chemistry.
**Students:** Victor has graduated two Computer Science Ph.D. students at Harvard University, one of whom, Karen Daniels, is now a tenured associate professor, and one interdepartmental Ph.D. students at UM: Harald Schmidl. He has advised and served on the committees of numerous master's degree students. He is currently advising and funding interdepartmental PhD. student Steven Trac on an NSF grant and hopes to transition Steven to the new Ph.D. program.

### Dr. Shahriar Negahdaripour, Secondary Appointment, Professor of Electrical and Computer Engineering

Ph.D. Electrical Engineering, 1987, MIT.
**Research Interests:** Underwater Vision and Imaging.
**Active Projects:** 1) Integrated high-precision opti-acoustic imaging and positioning platform for underwater search and inspection, ONR DURIP, June'06- June'07. 2) Investigation of Multiple-View 3-D Reconstruction Methods with FS Sonar Video Cameras ONR, June'05- April'08.

### Dr. Mitsunori Ogihara, Professor

Ph.D. Information Technology, 1993, Tokyo Institute of Technology.
**Research Interests:** Computational Complexity, Molecular Computation, Data-Mining, Bioinformatics.
**Students:** Alina Beygelzimer (PhD: 2003), Yin-He Cheng (PhD: 2004), Gabriel Istrate (PhD: 1999), Ashwin Lall (expected defense: May, 2008), Tao Li (PhD: 2004), Srinivasan Parthasarathy (PhD: 1999), Bin Wei (expected defense: May, 2010). Mohammed Javeed Zaki (PhD: 1998), Chengliang Zhang (expected defense: July, 2007).

### Dimitris Papamichail, Assistant Professor

Ph.D., 2007, SUNY at Stony Brook.
**Research Interests:** Bioinformatics, algorithms and data structures, optimization, decision sup-

port systems.

### Dr. Victor Pestien, Secondary Appointment, Associate Professor of Mathematics

Ph.D. Mathematics, 1980, University of California at Berkeley.
**Research Interests:** Probability, Optimization.
**Students** (Ph.D., Mathematics): Michael G. Monticino, "The adequacy of measurable and of stationary strategies for approximating optimal return", Mathematics and Computer Science, University of Miami, May, 1987. Xiaobo Wang, "Reward functions and Markov strategies in finite-stage stochastic decision problems", Mathematics and Computer Science, University of Miami, July, 1992. Kevin R. Ruth, "Favorable red and black on the integers with a minimum wager9', Mathematics and Computer Science, University of Miami, December, 1999.

### Dr. Subramanian Ramakrishnan, Secondary Appointment, Associate Professor of Mathematics

Ph.D. Mathematics, 1980, Indian Statistical Institute
**Research Interests:** Probability, Statistics.
**Students** (Mathematics): Carlos Canas, DA project, Queueing Networks in Discrete-time: Exact results and Approximations, 2004. 2) John Beam, Ph.D. thesis, Expectations for Coherent probabilities, 2002.

### Dr. Burton Rosenberg, Associate Professor and Director of Technology

Ph.D., 1991, Princeton University.
**Research Interests:** Cryptography and security; scientific visualization and computation; mathematical finance.
**Students:** Launched webmail project with undergraduate Matt Mankins. Eventually sold as emumail, www.emumail.com. Advised one master's student, served on the committee for six other master students.

### Dr. Dilip Sarkar, Associate Professor and Director of Graduate Studies

Ph.D., 1988, University of Central Florida.
**Research Interests:** High-speed Networks, Mobile and Wireless Computing, Multimedia Communication and Systems, QoS on the Web
**Students:** Dilip is supervising two interdisciplinary Ph.D. students at UM: Wing Tong and Wei

Zhou. He is also advising three master's students. In the past, Dilip has advised 25 master's degree students and served on the committees for several master's and Ph.D. degree students.

### Dr. Geoff Sutcliffe, Associate Professor and Director of Undergraduate Studies

Ph.D., 1992, The University of Western Australia.
**Research Interests:** Automated Theorem Proving (ATP), Evaluation of ATP Systems, Distributed and Parallel ATP
**Students:**
2005-2006 MS Supervisor, Shen W., Automated Proofs of Relationships Between Modal Logic Systems, University of Miami.
2004-2006 MS Supervisor, Moynihan K., Lascaux - An Intelligent Artistic Agent, University of Miami.
2003-2005 MS Supervisor, Zhang Y., The Use of Lemmas for Solving Hard Automated Theorem Proving Problems, University of Miami.
2003-2004 MS Supervisor, Gao Y., Automated Generation of Interesting Theorems, University of Miami.
1998-2003 MSc Supervisor, Brown M., Semantic Guidance for Linear ATP Systems, James Cook University.
1994 MSc Supervisor, Nugroho L., A Programmer's Tool for Managing Persistent Object Structures, James Cook University.
1990 MAppSc Supervisor, Tabada W., An Analysis and Implementation of Linear Derivation Strategies, Edith Cowan University.

## 6 Bulletin Description

This is the proposed bulletin description for the Ph.D. program.

### Doctor of Philosophy in Computer Science

The following requirements are in addition to the general requirements for the Doctor of Philosophy Degree as described by the Graduate School. The Computer Science Graduate Committee (CSGC) maintains full authority over all decisions pertaining to a Ph.D. student.

1. **Admission Requirements:** In order to be admitted to the Ph.D. program in Computer Science, an applicant must have obtained a minimum of 15 credits in courses at sophomore level and above. These courses in the computer science department at UM are numbered 200 and above. Applicants may be admitted with deficiencies; these must be completed in addition to the degree requirements.

2. **Written Qualifying Exam:** The student must pass a three-hour written exam of general knowledge of Computer Science at the end of the first year. Upon failure, the student may petition the CSGC to allow a second attempt at the end of the second year.

   The exam will be administered once a year in the early weeks of the summer session. It will cover expected knowledge of all first-year graduate students. Included in this material are a fundamental understanding of algorithm analysis and design, advanced skills in programming, basic knowledge of computer architecture, and a general understanding of computer systems.

3. **Classroom Course Requirements:** In the first two years, the student must take eight CSGC-approved classroom courses, for a total of 24 credits. At least four of these courses (12 credits) must be open only to graduate students. These courses at UM are numbered 600 and above.

   The eight courses must include two courses from each of the areas of Analysis, Applications, and Systems. The student should work with his or her advisor to select a cohesive set of courses as approved by the CSGC.

   The CSGC will have sole authority in designating the areas to which each course belongs. In the case that a course is designated in more than one area, a student may apply the course to only one area. The designation of current CSGC-approved courses appears at the end of this description.

4. **Project Course Requirements:** By the end of the second year the student must complete two graduate level project courses for a minimum total of 6 credits. Each project shall be under the supervision of a *different* faculty member in the Department.

   All Ph.D. students must find faculty willing to supervise their project in the semester preceding the project. The deadline for finding a supervisor shall be the first full week in April or November for the Fall and Spring terms, respectively. This deadline does not require identifying a specific project but only finding a faculty member willing to supervise a project.

   Upon completion of a project, the student must write a detailed project report. This report shall become a public document and shall be kept on file by the Department. The student must present the finished project to a quorum of the CSGC at a time to be approved by the chairman of the Department. The supervisor and CSGC must approve each project as applicable toward candidacy for a Ph.D. A primary factor in determining approval shall be the stated willingness of the supervisor to become an initial Ph.D. advisor for the student.

5. **Annual Presentations:** After passing the written qualifying exam, the student must make a public oral presentation to the Department at least once per year. These presentations include the two project presentations, the thesis proposal, and the thesis defense. The goals are to develop the student's oral and presentation skills, to provide a means for the Department to check the research and progress of the student, and to present the opportunity for feedback to improve the student's research.

6. **Teaching Experience:** Each student must teach a lab-based course for a minimum of one semester. Lab-based courses typically require the student to present material in a relaxed lecture format, re-emphasizing material learned in the general lecture as well as introducing new material to the students.

## Approved Course Categories

The following is a list of approved courses for each of the three categories:

### Analysis

| | | | |
|---|---|---|---|
| CSC 506 | Logic | CSC 612 | Theory of Complexity |
| CSC 517 | Data Structures and Algorithm Analysis | CSC 623 | Theory of Relational Databases |
| CSC 518 | Compiler Theory | CSC 628 | Parallel Algorithms |
| CSC 519 | Programming Languages | CSC 646 | Neural Computing |
| CSC 527 | Theory of Computing | CSC 647 | Computational Geometry |
| CSC 531 | Introduction to Software Engineering | EEN 634 | Modeling and Analysis of Computer Networks |
| CSC 540 | Algorithm Design and Analysis | EEN 656 | Information Theory |
| CSC 545 | Introduction to Artificial Intelligence | MTH 509 | Discrete Mathematics II |
| CSC 606 | Logic Programming | MTH 520 | Numerical Analysis I |
| CSC 609 | Cryptography and Data Security | MTH 521 | Numerical Analysis II |
| CSC 611 | Theory of Computation | MTH 528 | Combinatorics |

### Applications

| | | | |
|---|---|---|---|
| CSC 523 | Principles of Filing and Database Systems | CSC 648 | Automated Reasoning |
| CSC 529 | Introduction to Computer Graphics | CSC 655 | Advanced Multimedia Systems |
| CSC 545 | Introduction to Artificial Intelligence | EEN 577 | Data Mining |
| CSC 555 | Multimedia Systems | EEN 638 | Computer Vision |
| CSC 628 | Parallel Algorithms | EEN 653 | Pattern Recognition and Neural Networks |
| CSC 645 | Expert System Design | MTH 520 | Numerical Analysis I |
| CSC 646 | Neural Computing | MTH 521 | Numerical Analysis II |

### Systems

| | | | |
|---|---|---|---|
| CSC 518 | Compiler Theory | CSC 645 | Expert System Design |
| CSC 519 | Programming Languages | CSC 655 | Advanced Multimedia Systems |
| CSC 521 | Principles of Computer Operating Systems | EEN 514 | Computer Architecture |
| CSC 523 | Principles of Filing and Database Systems | EEN 534 | Computer Communication Networks |
| CSC 524 | Networks and Information Security | EEN 614 | Advanced Computer Architecture |
| CSC 555 | Multimedia Systems | EEN 634 | Modeling and Analysis of Computer Networks |
| CSC 609 | Cryptography and Data Security | EEN 671 | Advanced Interactive Multimedia Information Systems |

# 7 Questions and Answers

Q: Are the courses in place to offer a Ph.D. and are they being taught?
A: Yes and yes. Our master's program is unashamedly research-oriented and we graduate many master's students each year, many of whom write master's theses that are published in journals. No new courses are planned for the Ph.D. program, nor do we plan to change the frequency. Section 8 provides data on the number of master's degrees bestowed in the past five years. Section 8 also provides data on past and planned future course offerings at the undergraduate and graduate level.

Q: How will we support the new Ph.D. students?
A: The department is able to award seven teaching assistantships to highly qualified students. Currently, we can only offer these to master's students. Obviously, we will also seek funding from outside the university for research assistantships. There is a shortage of Ph.D.s in Computer Science, and there is much external funding available for graduate work.

Q: What about the $100,000/year/faculty external funding?
A: A mature, successful Ph.D. program is *necessary* to reach this national average, but it is not necessarily *sufficient*. It is mere speculation that we will ever reach this level of external funding. *Instead*, this proposal is based solidly on past performance and current resources.

Q: Won't the number of master's students decrease as a result of shifting the resources?
A: Possibly but gradually: we plan to be very selective in the admission of Ph.D. students, leaving the remaining teaching assistantships for highly qualified master's students as before.

Q: Shouldn't we hire a few more faculty before establishing a Ph.D. program?
A: By requiring that student do research projects with two different faculty for candidacy, the new program is specifically designed to avoid "orphaning". Furthermore, with an established record of assigning teaching assistantships to master's students, we can afford to offer assistantships only to those Ph.D. applicants whose interests closely fit those of the faculty. Since a significant portion of potential *faculty* applicants will eschew a university without a Ph.D. program, perhaps the question should be, "Shouldn't we establish a Ph.D. program before hiring more faculty?"

Q: Won't the new Ph.D. program steal faculty time away from the undergraduates?
A: Again, quite the opposite: the *lack* of a Ph.D. program steals time from the undergraduate program. Given the universality of Ph.D. programs at research institutions, our faculty are expected to have a certain level of productivity in order to obtain grants and promotions. With a master's student, a faculty member has to spend much time and effort getting the student up to speed only to generate perhaps one joint paper. A Ph.D. student requires hardly more effort and leads to a much longer and more fruitful collaboration. So basically, the lack of a Ph.D. program means that faculty have to take time away from undergraduates in order to train graduate students.

Q: How does this program relate to those provided by the universities listed in Section 8?
A: For the most part, the program follows that of Johns Hopkins, also a young department. It

Table 1: Comparison of proposed program with several AAU universities. JHU=The Johns Hopkins University; UNC=The University of North Carolina at Chapel Hill; UFL=University of Florida, Gainesville.

| | UM | JHU | Duke | UNC | UFL |
|---|---|---|---|---|---|
| concentration courses | 2 | 2 | 4 | 3 | 4 |
| breadth courses | 6 | 6 | 4 | 6 | 6 |
| project courses | 2 | 2 | 0 | 0 | 0 |
| annual presentations | yes | yes | no | no | no |
| attend colloquia | no | yes | no | yes | yes |
| teaching | yes | yes | no | no | yes |
| written qualifier | yes | no | yes | yes | yes |
| oral qualifier | no | yes | no | yes | no |

requires courses in three areas–Analysis, Applications, and Systems–and it requires projects with two different faculty members. Table 7 compares the proposed program to Ph.D. programs at JHU and other nearby AAU universities. We note that many departments require attendance at colloquia. The Computer Science Department currently requires graduate students to attend as a condition of receiving a teaching assistantship.

# 8 Additional Supporting Materials

1. Approval of College of Arts and Sciences, November 16, 2004.
2. Total number of MS degrees awarded in the last five years.
3. Undergraduate and graduate teaching of computer science courses: 1994-2000.
4. Undergraduate and graduate teaching of computer science courses: 2000-2007 (anticipated).
5. CV: Huseyin Kocak
6. CV: Thomas LeBlanc
7. CV: Victor J. Milenkovic.
8. CV: Shahriar Negahdaripour
9. CV: Mitsunori Ogihara
10. CV: Dimitris Papamichail
11. CV: Victor Pestien

12. CV: Subramanian Ramakrishnan
13. CV: Burton Rosenberg.
14. CV: Dilip Sarkar.
15. CV: Geoff Sutcliffe.
16. 2005-2006 CRA Taulbee Survey.
17. 2004-2005 CRA Taulbee Survey.
18. 2001-2002 Industry Salary Survey
19. CRA Forsythe List of Ph.D.-granting departments.
20. List of Florida Ph.D.-granting departments.
21. Johns Hopkins University (CS Dept), Program for Ph.D. students.
22. Duke University (CS Dept), Program for Ph.D. students.
23. University of North Carolina (CS Dept), Program for Ph.D. students.
24. University of Florida (CS Dept), Program for Ph.D. students.
25. Graduate Education in Computational Science and Engineering. *SIAM Review*, Volume 43, Number 1, pp. 163-177.
26. Proposal to the Faculty Senate to establish a new Department of Computer Science, approved January 1999.

UNIVERSITY OF Miami

**MEMORANDUM**

March 10, 2008

TO: Faculty Senate

FROM: Hüseyin Koçak
Chair, Department of Computer Science

SUBJECT: Ph.D. Program in Computer Science

This memo serves to confirm that the Department of Computer Sciences faculty unanimously approved the Ph.D. Program in Computer Science. The proposal is now forwarded to the Faculty Senate for action. No additional funds are being requested for the successful implementation of the proposed Ph.D. program in Computer Science.

Department of Computer Science
College of Arts & Sciences
P.O. Box 248154
Coral Gables, Florida 33124-4245
305-284-2268
Fax: 305-284-2264

MEMORANDUM

To: Chair, Faculty Senate,

FROM: Dean Terri Scandura, Graduate School Terri A. Scandura

DATE: 29 February 2008

SUBJ: New Graduate Program in Computer Science

At the 27 October 2007 meeting of the Graduate Council the proposed Ph.D. program in Computer Science was approved unanimously by those present.

CC: SACS Office
Graduate School Program Review File

**MEMORANDUM**

TO: Steve Ullmann
Vice Provost and Dean of Graduate Schools

FROM: Angel Kaifer
Vice Dean for Life and Physical Sciences

SUBJECT: Ph.D. Program in Computer Science

At its meeting on 16 November 2004, the College of Arts and Sciences faculty unanimously approved the Ph.D. Program in Computer Science. The proposal is now forwarded to the Graduate Council for action.

cc: Huseyin Kocak, Interim chair
Department of Computer Science

Attachment: Ph.D. in Computer Science Proposal

UNIVERSITY OF Miami
COLLEGE OF ENGINEERING

**MEMORANDUM**

To: H. Kocak, Chairman, CS Department

CC: J. M. Tien, Dean CoE; S. Sapp, Chairman, Faculty Senate

From: J. W. Modestino, Chairman, ECE Department

Date: March 25, 2008

Re: Support of CS Ph.D. Program Proposal

As you have requested, the ECE Department would like to formally endorse and support the proposal by the CS Department to create a Ph.D. program in Computer Science. We have examined the proposal and it appears academically sound and certainly appropriate given the expanding research interests and capabilities in the CS Department. It is our hope that this development could enhance the potential for stronger research collaborations between CS and ECE faculty, and their respective students.

Our only concern at this point is that there be in place a mechanism for coordinating the development of new graduate course offering between the two Departments to avoid the potential for wasteful duplication of effort. Specifically, this could be accomplished by having the respective graduate program coordinators in each Department coordinate the introduction and scheduling of graduate courses so that students in both Departments can take advantage of such offerings while avoiding wasteful use of faculty resources.

Subject to this single concern, the ECE Department strongly supports this proposal.

Department of Electrical and Computer Engineering • P.O. Box 248294 • Coral Gables, Florida 33124-0640
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UNIVERSITY OF Miami

March 26, 2008

STATEMENT OF SUPPORT
PHD PROPOSAL IN COMPUTER SCIENCE
Prof. Zame
Chair, Mathematics Department

With very few exceptions major research universities have excellent Computer Science Departments with PhD programs. Computer science was part of mathematics for many years and the goal was always to start a PhD program once there were sufficient faculty, which was generally considered to be six to eight, with most tenured. We never reached that level. Computer science was separated from Mathematics at the end of the '90's and it has now finally become substantial enough to support a PhD program. There are currently four full professors, three tenured associate professors and one junior faculty member in the department. There is also considerable interest and support available for computer science elsewhere in the College of Arts and Sciences and the University as a whole. There is now a supercomputer center. There are very good faculty in the Department, but these faculty need the kind of students they would get in a PhD program to continue their work and obtain more funding. Up until now, faculty had to have PhD students in some interdisciplinary programs, making it more difficult for all involved. The proposed new degree does not initially call for new faculty or resources. My assumption would be that if the program progresses as hoped then new resources will be developed over time.

In short, it is necessary for the University of Miami, if it is ever going to achieve its aspiration of AAU membership, to have a viable PhD program in computer science, and the department has progressed to the point that the program is now feasible. This program is long overdue.

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**March 26, 2008**
**Faculty Senate minutes**

The meeting, held in the BankUnited Center Hurricane 100 Room, opened at 3:35 p.m.

**CHAIR'S REMARKS**
The First Vice Chair announced that she will be chairing today's meeting and highlighted some of the information in the Chair's remarks that were part of the agenda package.

**PRESIDENT'S REMARKS**
The President explained that she and the Provost were in the middle of the SACS on-site review visit. She reported on the new hospital and said that we are on-budget and are about to complete the permanent financing, which will be less than what was projected due to the market. She had warned the trustees that the rating agencies might downgrade us because of the debt load we would be incurring, but instead they noted our strong balance sheets and did not downgrade us.

We are struggling in Tallahassee because the Senate has cut FRAG money for each Florida student attending private colleges and universities. Our full-time lobbying staff is still fighting this legislation. We also expect some other programming cuts.

The Board of Trustees Finance Committee approved the Financial Plan that accompanies the Strategic Plan and recommended construction of the new Business School building in anticipation of its approval by the Master Planning and Construction Committee.

The Provost shared that the SACS on-site team is concluding its work on campus and is meeting in executive session now to formulate its findings and recommendations. He feels that the visit is going well and thanked everyone who participated.

He stated that the Miller School of Medicine portion of the Strategic Plan went to the Board's Medical Affairs Committee this morning for their approval and will then be forwarded to the Executive Committee. As the President mentioned, the Financial Plan as presented earlier to the Senate's Budget and Compensation Committee was approved by the Board Finance Committee, and the Administration is hopeful that it will be approved in May by the Board.

The Provost reported on the University's investments. For the last fiscal year, 2007, our return on the growth pool was 19.7% for the year. The benchmark we were attempting to beat was 17.7%. So far for fiscal year 2008 we are down 4.9%. Our benchmark is 4.3%. UM uses a three-year moving average that smoothes out discontinuities in the market. The President and Provost entertained questions from the floor.

**APPROVAL OF TODAY'S AGENDA**
The meeting agenda *passed unanimously.*

## APPROVAL OF MINUTES OF FEBRUARY 27, 2008

The minutes of February 27, 2008, *passed unanimously.*

## INTRODUCTION OF SHERI A. KEITZ, M.D. PH.D.

Dr. Keitz is the Associate Dean for Faculty Diversity and Development, Miller School of Medicine. She has been a physician for about 18 years and her goal is to do what she can to optimize the care of the patient and populations that we work with and to make an impact on the future. She thanked the Senate for its work in extending the tenure clock at the Miller School of Medicine.

## MIAMI INSTITUTE FOR HUMAN GENOMICS [MIHG] AND COMPONENT CENTER PROPOSALS

[Please contact the Senate office to view the proposal.]
Jennifer McCafferty-Cepero presented the proposal with the suggestions requested and approved by the General Welfare Committee. She reviewed the proposal that creates an umbrella institution called the "Miami Institute for Human Genomics" with five separate component centers. The intent is for the centers to exist within the umbrella institute and not to exist in the absence of that institute as was recommended by the General Welfare Committee. The institute will reside initially at the Miller School of Medicine and will house disciplines that draw from a variety of departments at the Miller School. The letters of support for the institute come from all of the basic science chairs, a majority of the clinical departments that have research activities, and the major centers and institutes that already exist at Miller. The five-year projected plan was inadvertently missing from the proposal included with the materials so Dr. McCafferty-Cepero gave an oral summary. She then entertained questions from the floor.

A senator stated that he expects to see regular review of centers and institutes, and another senator asked about provisions to address the ethical aspects raised by advances in human genetics. Dr. McCafferty-Cepero responded that the institute is developing a program in conjunction with Dr. Ken Goodman of the University Ethics Programs.

*A motion was made and seconded* to approve the proposal. The motion was *approved unanimously.*

## PROPOSAL FOR A DOCTOR OF PHILOSOPHY IN COMPUTER SCIENCE

[Please contact the Senate office to view the proposal.]
Huseyin Kocak presented the proposal for a Doctor of Philosophy in Computer Science. He pointed out that he had received additional letters of support as was requested by the Senate Chair. There is no additional funding needed. There were no questions.

*A motion was made and seconded* to approve the proposal. The motion was *approved unanimously.*

**PROPOSAL FOR A NEW DEGREE PROGRAM, THE MASTER IN REAL ESTATE DEVELOPMENT AND URBANISM (MRED&U)**
[Please contact the Senate office to view the proposal.]

Dean Elizabeth Plater-Zyberk was accompanied by Charles Bohl and presented the proposal. She discussed the aspects of design and the larger context of sustainable and livable communities, with concerns for environmental conservation, social equity, and economics. The University of Miami School of Architecture is recognized as the top school in the country for presenting the principles of the new urbanism. The Knight Program in Community Building has brought significant experience in the implementation of the principles, which have been built in and espoused by the faculty. This new degree is intended to be a mid-career program that will work with fellows of multiple disciplines and communities around the country under the sponsorship of the Knight Program. The comments of the General Welfare Committee regarding incorporation of ecological responsibility into the degree were endorsed by the school's faculty and wording was added to the proposal to reflect this commitment. The presenters entertained questions and comments from the floor.

*A motion was made and seconded* to approve the proposal. The motion was *approved unanimously.*

**ACADEMIC STANDARDS COMMITTEE UNDERGRADUATE ADMISSION REPORT**
[Please contact the Senate office to view the proposal.]
Dr. R. Stephen Cantrell, *ex officio* member of the committee, noted that the report is a continuation of reports in the past. He highlighted the comparisons of the university with other universities in the report and entertained questions from the floor. The Provost also reiterated some of the points of his presentation at the last Senate meeting. The Provost also entertained comments/questions from the floor.

*A motion was made and seconded* to accept the report. The motion was *approved unanimously.*

*A motion was made and seconded* to adopt the recommendation of the committee as the Senate's recommendation. The motion was *approved unanimously.*

**MOVE OF MASTER OF PUBLIC ADMINISTRATON FROM THE SCHOOL OF BUSINESS TO THE COLLEGE OF ARTS AND SCIENCES**
The First Vice Chair presented the proposal to move the Master of Public Administration from the School of Business to the College of Arts and Sciences.

*A motion was made and seconded* to approve the proposal. The motion was *approved unanimously.*

**SENATE APPORTIONMENT**
The First Vice Chair presented the General Welfare Committee's recommendation that the apportionment constant be kept at 10, increasing the number of senators to 50 by adding one senator for the Miller School of Medicine and one for the Frost School of Music.

*A motion was made and seconded* to approve the proposal. The motion was *approved unanimously.*

**NOMINATING COMMITTEE**

The Vice Chair pointed out that the Chair is willing to serve as chair again next year and thus has suggested that the Senate elect the Nominating Committee for next year's Senate officers. Norman Einspruch, Marvin Dawkins, Lenny Koniaris, Patricia Byers, and Lynne Fieber were nominated from the floor.

*A motion was made and seconded* to elect these individuals as the Nominating Committee. The motion was *approved unanimously.*

The remainder of the meeting was held in Executive Session to discuss the Outstanding Teaching Award recommendation.

The meeting adjourned at 6:09 p.m.

Respectfully Submitted,
Robyn Hardeman
Secretary of the Faculty Senate

# General Welfare Committee
# March 19, 2008
# 3:30 p.m.
# (School of Law Library-Conference Room, 4th floor)

1. Chair's remarks (3:30)
2. # Review of draft Faculty Senate Meeting Minutes of February 27, 2008 (3:35)
3. # Miami Institute for Human Genomics and Component Center Proposals – J. McCafferty-Cepero (3:40)
4. # Proposal for a Doctor of Philosophy in Computer Science – H. Kocak (3:55)
5. ## Academic Standards Committee Undergraduate Admission Report – (4:10)
6. ## Proposal Regarding Latin Honors – (4:25)
7. Outstanding Teaching Award Committee Recommendation – E. Clasby (4:40)
8. # Request for Guidance Concerning Doctoral Study in Their Home Department/School by Masters-Prepared Faculty in Physical Therapy and Nursing – S. Hayes, V. Mitrani (4:50)
9. # Proposal for a New Degree Program, the Master in Real Estate Development and Urbanism (MRED&U) – C. Bohl, D. Hector (5:20)
10. # Move of Masters of Public Administration from the School of Business Administration to the College of Arts and Sciences – Note: a memo from the Dean of Arts and Sciences will be forthcoming - (5:35)
11. # Senate Apportionment - (5:40)

# related material included
## materials will be sent separately

# A Proposal for a New Degree Program
# Doctor of Philosophy in Computer Science

Unanimously Approved by College of Arts and Science, November 16, 2004

Revised: November 29, 2007 *

Department of Computer Science
College of Arts and Sciences
University of Miami

*Introduction and personnel updated. No changes have been made to requirements of program.

# Contents

## 8 Additional Supporting Materials

# 1 Introduction

## 1.1 The Field of Computer Science

Computer science is the systematic study of computation. The fundamental building blocks of the field are algorithms, the descriptions of computational processes in terms of well-defined instructions. Algorithms capture underlying ideas behind computation and enable conversations among scientists without having to use specific programming languages. While the concept of algorithms has existed for more than two millenia, it is only in the later part of the last century that the first academic computer science departments were created. Despite its infancy, however, the field of computer science has grown at a remarkable speed and has now acquired a prominent position in academic institutions, both in the states and in other modern countries. The growth is in part due to the rapid advancements in computer technologies, as observed in the so-called Moore's law, which states that the density of transistors on computer chips doubles every eighteen months. However, what truly propelled the growth are the ingenious concepts and earth-shaking algorithms produced by computer scientists, which have made computing more interesting, more effective, and more accessible. Such ideas include computer graphics, email, object-oriented programming, public-key cryptography, sorting, string matching, virtual reality, and world-wide web. The influence of those revolutionary ideas have gone very far beyond the boundary of computer science. Computing has become not only a central tool for many fields of natural sciences, engineering, social sciences, business, medicine and arts but an essential part of human life. This unprecedented ubiquity puts computer science in a very unique position in academe and makes it one of the most important, if not the most important, disciplines of the 21st century.

Critical missions of any scholastic discipline are research and education, and in many disciplines the two missions are intricately related with each other. This is certainly the case for computer science. In most research areas of computer science, investigations are through experimentation involving complex computer programs. Academic computer scientists can therefore speed up substantially their research investigations by teaming up with graduate students that understand and implement underlying scientific ideas. This partnership between the advisers and the advisees are mutually beneficial. While the gain of speed allows the researchers to produce more results, the graduate students receive critical training through hands-on research experience. Since even the most advanced computing technologies of today may be become outdated tomorrow, graduate computer science training must instill in students universal research skills that stand the test of time.

## 1.2 The UM Computer Science Department

At the University of Miami, the Computer Science Department was created in 2000 out of the Mathematics Department, in part for the purpose of serving the growing demands of the UM undergraduate students to receive education in the field. The research expertise of the current

Computer Science tenure-track faculty touches upon a variety of key research areas: artificial intelligence, automated reasoning, bioinformatics, computational complexity, computational geometry, computer graphics, cryptography and security, data mining, large-scale modeling, molecular computation, multimedia systems, and network algorithms. The initially-approved target size of the graduate faculty is eight, and the department has currently seven tenure-track faculty members (five of them are tenured). The existing tenure-track faculty members received graduate training in the areas that have a strong focus on algorithms, i.e., the abstract ideas underlying computation. This makes them ideal for teaching students how to think creatively using standard methodologies as well as how to transfer ideas from one subject to another. The proximity of the Department to researchers in the University whose work heavily uses computation (those in the Departments of Biology, Chemistry, and Physics on the Coral Gables Campus and those in the Schools of Marine and Atmospheric Sciences and of Medicine) offers tremendous advantage for these researchers to engage in interdisciplinary collaboration with members of the Department. In fact, the Computer Science Department has a proven record of exploring such opportunities to produce excellent research outcomes, and of training students through such projects. The Department takes its pride in having sent both of its undergraduate and graduate students to top jobs, both in the mainstream computer science field and in interdisciplinary fields, such as bioinformatics.

The interdisciplinary research of the Department is expected to be strengthened further through its involvement with the recently created Center for Computational Sciences. The Center is expected to offer five core research programs, each led by a director having a tenure-track primary appointment. So far only one core program director has been recruited, and that director is primarily appointed in Computer Science. The rest of the program directors will be recruited in the next two years, and one or two of them are likely also to have appointments in Computer Science. Also, it is anticipated that many of the in-house Ph.D. researchers of the Center, who directly report to program directors, will have formal affiliations with the Department. The affiliation of the directors and the researchers gives a tremendous opportunity for the Department to extend its research horizon and widen its educational programs. The Department believes that by capitalizing this unique opportunity it will be able to boost its external research funding substantially, produce more high quality research, and enrich its educational programs, and thereby increase its visibility both within the University and in the national and international computing research communities.

## 1.3 The Purpose of This Document

Establishing a Ph.D. program will greatly speed up the research progress and make the Department significantly more productive and more visible. The Department hereby requests approval to establish such a program, with the goal of enrolling the first batch of students in the academic year of 2008-09.

The requested Ph.D. leverages the existing mature Master of Science program in Computer Science, which the Department inherited from the Mathematics program and which has been graduating

students since 1971. Since 1996, the Master of Science program has graduated 54 students[1]. The classroom courses taught for the Master of Science program (and in the Computer Engineering program) are sufficient for starting a Doctor of Philosophy program in Computer Science of minimum breadth. (See the table of Computer Science courses taught from 1994 to 2007 in Section 7.)

### 1.4 Outline of the Rest of the Document

Section 2 discusses the expected outcomes of the requested Ph.D. program. Section 3 provides the description of the new program, which closely follows the Ph.D. curriculum in computer science at several prominent universities. Section 3.5 presents the current categorized list of approved graduate-level courses. Section 4 describes the resources available to the students of the new program. Section 5 gives a short description of each graduate faculty member in the Department of Computer Science. Section 6 provides the text that should be added to the graduate bulletin. Section 7 answers some common questions about the proposal. Section 8 gives additional supporting material. Curriculum Vitae are attached.

## 2 Expected Outcomes

### 2.1 Interdisciplinary Ph.D. Programs

The March 2001 issue of the SIAM Review contains an article describing an influential program that mixes a graduate Computer Science curriculum with other science and engineering-oriented curricula. The article states, "Computational science and engineering (CSE) is a rapidly growing multidisciplinary area with connections to the sciences, engineering, mathematics, and computer science." The influence of Computer Science is strong in such fields as biology, chemistry, physics, medicine, and bioengineering. Many universities across the country have already established such interdisciplinary programs, in particular, establishing interdisciplinary programs in computational biology/bioinformatics has been a trend in the past few years. For example, the CSE Program at Purdue University "offers [MS and Ph.D.] specializations in computational science and computational engineering in 17 departments..." Although such an interdisciplinary program is certainly worth pursuing, before the University can create such a program it must have as a basis to cover the fundamentals, including a strong Ph.D. program in Computer Science.

### 2.2 Undergraduate and Graduate Relationships

Graduate teaching assistants, who currently are master's students, run course labs (for courses with a lab in addition to a lecture), grade homework, and monitor the teaching lab during non-class daytime hours, nights, and weekends, when the undergraduates work on their programming

[1] See Section 8

assignments. Since Ph.D. students will remain in the Department longer than master's students, they will have more time to gain research and teaching experience. This teaching experience will directly benefit the undergraduate Computer Science program and the undergraduate students in the University. For example, a Ph.D. student will have the opportunity to assist a greater variety of courses and thus is more likely to be able to answer a question posed by an undergraduate when the Ph.D. student is monitoring the teaching lab.

In addition to enhancing the current duties of teaching assistants, Ph.D. students will serve two new roles. First, Ph.D. students will help bridge faculty research to undergraduates. Second, Ph.D. students act as role models for undergraduates. Their influence will motivate talented undergraduates to pursue research and enter Ph.D. programs. Successful researchers generally remember their undergraduate years and the influence it had on their decision to pursue post-graduate studies.

One might think that a Ph.D. program would shift faculty time away from the undergraduate program, but quite the opposite is true: the *lack* of a Ph.D. program steals time from the undergraduate program. Given the universality of Ph.D. programs at research institutions, the Department faculty are expected to have a certain level of productivity in order to obtain grants and promotions. With a master's student, a faculty member has to spend much time and effort getting the student up to speed only to generate perhaps one joint paper. A Ph.D. student requires hardly more effort and leads to a much longer and more fruitful collaboration. The lack of a Ph.D. program means that faculty have to take time away from undergraduates in order to train graduate students.

## 2.3 Job Market Prospects

Computer Science graduates earn some of the highest salaries among all college-level graduates. The benefits of a Computer Science degree for an undergraduate are well understood. Having a Ph.D. in Computer Science presents further benefits. The tremendous amount of resources being devoted to information sciences ensures that a Ph.D. in Computer Science will remain a major asset for many years. Upon graduation, a Ph.D. student can expect to find numerous research jobs in both academia and industry.

According to the 2005-2006 Taulbee Survey, Table 4, 26.0% of Ph.D. recipients find employment in North American Ph.D.-granting departments: 12.8% tenure-track, 2.6% researcher, 8.9% postdoc, and 1.7% teaching faculty. 5.2% find positions in other CS/CE departments. 49.4% find jobs in industry and 2.5% in government. Only 0.7% were unemployed. According to Table 27, the mean and median salary for NTT faculty was above $62,000. The mean and median salary for assistant professors was above $84,000. According to the 2002 Industrial Salary Survey of CS Research Labs (the latest available), the mean and median salary for a new Ph.D. was above $99,000.

Clearly, the demand for qualified researchers in Computer Science is high, and the prospects of a Ph.D. graduate in Computer Science are good.

# 3 Description

## 3.1 Exact Title of Degree

DOCTOR OF PHILOSOPHY IN COMPUTER SCIENCE

## 3.2 Overview

To earn a Ph.D. in Computer Science, a student must satisfy all the general requirements for a Ph.D. set by the graduate school: standardized tests, grade point average, residency, minimum credit distributions, *etc.* The following requirements are those which are specific to the Computer Science program. The goal of this program is to provide the Ph.D. student with both overall *breadth* in the field and *depth* in a particular area of concentration. To that end, the curriculum is broken into several categories:

- **A written qualifying examination** demonstrating advanced general knowledge (breadth) in Computer Science.
- **Course requirements** covering material in many areas, strengthening breadth, and extra course work in one particular area, strengthening depth.
- **Two research projects** building depth of knowledge in a particular field, as well as strengthening relationships between faculty and students for possible dissertation work.
- **Thesis proposal and defense**, accompanied by an oral exam to demonstrate significant depth in the chosen field.
- **Annual presentations** to demonstrate depth of knowledge, strengthen presentation skills, and provide a means of overseeing the student's progress.
- **Teaching experience** to strengthen both the student's presentation skills and the ability to explain materials in a coherent manner.

A Ph.D. student successfully completing the requirements in all of these categories will have demonstrated significant knowledge and understanding of the field of Computer Science and shall be deemed ready to use that knowledge in the broader community.

## 3.3 Admission Requirements

In order to be admitted to the Ph.D. program in Computer Science, an applicant must meet all of the requirements set by the Graduate School including adequate scores on the GREs. In addition, a minimum of 15 credits in Computer Science courses numbered 200 and above is required. Students may be admitted with deficiencies; these must be completed in addition to the degree requirements.

## 3.4 Ph.D. Degree Requirements

Upon completion of the curriculum, the student will have earned at least 60 credit hours beyond that of a bachelor's degree. Minimally, 12 credits will have come from dissertation research, 6 credits from research projects, and 24 credits from classroom courses. However, a typical student will have earned 24 credits from dissertation research, 12 credits from research projects, and 24 credits from classroom courses. At least 30 credits must be at the 600-level or higher. The student must also have obtained a minimum of 24 credits while in residence at UM. The Computer Science Graduate Committee (CSGC) maintains full authority over all decisions pertaining to a Ph.D. student. In particular, the acceptance of credits transferred by the student from another post-graduate institution shall be determined by the CSGC.

As specified by the Graduate School, degree requirements must be completed within eight years of the time of admission to graduate work and within four years of passing the qualifying examination. A Computer Science Ph.D. student shall be deemed to have passed the qualifying examination process upon completion of the written qualification examination and the research project requirements.

What follows is a more in-depth description of the categories, detailing the various criteria the student is expected to meet.

### Written Qualifying Exam

Every Ph.D. student must pass a three hour written exam of general knowledge of Computer Science at the end of the first year. Upon failure, the student may petition the CSGC to allow a second attempt at the end of the second year.

The exam will be administered once a year in the early weeks of the summer session. It will cover expected knowledge of all first-year graduate students. Included in this material are a fundamental understanding of algorithm analysis and design, advanced skills in programming, basic knowledge of computer architecture, and a general understanding of computer systems.

### Classroom Course Requirements

In the first two years, the student must take eight CSGC-approved classroom courses, for a total of 24 credits. At least four of these courses (12 credits) must be at the 600 level (only available to graduate students). The eight courses must include two courses from each of the areas of Analysis, Applications, and Systems. The student should work with his or her advisor to select a cohesive set of courses as approved by the CSGC.

The CSGC will have sole authority in designating the areas to which each course belongs. In the case that a course is designated in more than one area, a student may apply the course to only one area. The designation of current CSGC-approved courses appears in Section 3.5.

### Project Course Requirements

By the end of the second year the student must complete two graduate level project courses for a minimum total of 6 credits. Each project shall be under the supervision of a *different* faculty member in the Department.

All Ph.D. students must find faculty willing to supervise their project in the semester preceding the project. The deadline for finding a supervisor shall be the first full week in April or November for the Fall and Spring terms, respectively. This deadline does not require identifying a specific project but only finding a faculty member willing to supervise a project.

Upon completion of a project, the student must write a detailed project report. This report shall become a public document and shall be kept on file by the Department. The student must present the finished project to a quorum of the CSGC at a time to be approved by the chairman of the Department. The supervisor and CSGC must approve each project as applicable toward candidacy for a Ph.D. A primary factor in determining approval shall be the stated willingness of the supervisor to become an initial Ph.D. advisor for the student.

### Dissertation Committee, Proposal, and Defense

Upon completion of the two projects, the CSGC shall appoint a Dissertation Committee for the student as required by the Graduate School. The student must present a thesis proposal by the end of the fourth year. Both proposal and defense will include a public oral presentation followed by questioning from the Dissertation Committee.

### Development of Presentation Skills

After passing the written qualifying exam, the student must make a public oral presentation to the Department at least once per year. These presentations include the two project presentations, the thesis proposal, and the thesis defense. The goals are to develop the student's oral and presentation skills, to provide a means for the Department to check the research and progress of the student, and to present the opportunity for feedback to improve the student's research.

### Teaching Experience

Since Ph.D. graduates should be qualified to work in academia, each student must teach a lab-based course for a minimum of one semester. Lab-based courses introduce the student to working closely with both a faculty member and undergraduate students. These courses typically require the student to present material in a relaxed lecture format, re-emphasizing material learned in the general lecture as well as introducing new material to the students.

## 3.5 Approved Course Categories

The following is a list of approved courses for the classroom course requirements:

### Analysis

| | |
|---|---|
| CSC 506 | Logic |
| CSC 517 | Data Structures and Algorithm Analysis |
| CSC 518 | Compiler Theory |
| CSC 519 | Programming Languages |
| CSC 527 | Theory of Computing |
| CSC 531 | Introduction to Software Engineering |
| CSC 540 | Algorithm Design and Analysis |
| CSC 545 | Introduction to Artificial Intelligence |
| CSC 606 | Logic Programming |
| CSC 609 | Cryptography and Data Security |
| CSC 611 | Theory of Computation |
| CSC 612 | Theory of Complexity |
| CSC 623 | Theory of Relational Databases |
| CSC 628 | Parallel Algorithms |
| CSC 646 | Neural Computing |
| CSC 647 | Computational Geometry |
| EEN 656 | Information Theory |
| EEN 634 | Modeling and Analysis of Computer Networks |
| MTH 509 | Discrete Mathematics II |
| MTH 520 | Numerical Analysis I |
| MTH 521 | Numerical Analysis II |
| MTH 528 | Combinatorics |

### Applications

| | |
|---|---|
| CSC 523 | Principles of Filing and Database Systems |
| CSC 529 | Introduction to Computer Graphics |
| CSC 545 | Introduction to Artificial Intelligence |
| CSC 555 | Multimedia Systems |
| CSC 628 | Parallel Algorithms |
| CSC 645 | Expert System Design |
| CSC 646 | Neural Computing |
| CSC 648 | Automated Reasoning |
| CSC 655 | Advanced Multimedia Systems |
| EEN 638 | Computer Vision |
| MTH 520 | Numerical Analysis I |
| MTH 521 | Numerical Analysis II |

### Systems

| | |
|---|---|
| CSC 518 | Compiler Theory |
| CSC 519 | Programming Languages |
| CSC 521 | Principles of Computer Operating Systems |
| CSC 523 | Principles of Filing and Database Systems |
| CSC 524 | Networks and Information Security |
| CSC 555 | Multimedia Systems |
| CSC 609 | Cryptography and Data Security |
| CSC 645 | Expert System Design |
| CSC 655 | Advanced Multimedia Systems |
| EEN 514 | Computer Architecture |
| EEN 614 | Advanced Computer Architecture |
| EEN 534 | Computer Communication Networks |
| EEN 634 | Modeling and Analysis of Computer Networks |

## 3.6 Projected Program Size

Here is a conservative projected graduate program size.

| year | 1st | 2nd | 3rd | 4th | 5th |
|---|---|---|---|---|---|
| M.S. | 16 | 15 | 14 | 13 | 12 |
| Ph.D. | 2 | 4 | 6 | 8 | 10 |
| Total | 18 | 19 | 20 | 21 | 22 |

As resources are diverted from the master's program to the Ph.D. program, the number of master's students may decrease, but the total number of graduate students will increase.

# 4 Resources

The Department of Computer Science already has the resources to support the research of its faculty, its Master of Science program, and a Ph.D. program.

## 4.1 Teaching Assistantships

The Department has an allocation of seven teaching assistantships. Interdisciplinary Ph.D. students currently associated with the Department are also supported by individual faculty research funds, the university fellowship program, and the McKnight Fellowship program. Given the diversity of funding available for graduate students in Computer Science, no additional allocation of teaching assistantships is required.

## 4.2 Current Funding

Huseyin Kocak, Burt Rosenberg, Brian Coomes (Mathematics), $299,000, NSF.
Huseyin Kocak, RSMAS (F. Beron-Vera, M. Brown, M. Olascoaga), $900,000, NSF.
Victor Milenkovic, $240,000, NSF.
Dilip Sarkar, $27,650, University of Miami Small Grant.
Geoff Sutcliffe, $20000, Unrestricted gift to the University of Miami in support of Research in Automated Reasoning, Articulate Software.
Geoff Sutcliffe (PI), Huseyin Kocak (co-PI), Burt Rosenberg (co-PI), Victor Pestien (co-PI) (Mathematics), $467575, Computer Science and Mathematics for Scientists, NSF Scholarships in Science, Technology, Engineering, and Mathematics.
Geoff Sutcliffe, $1500, Unrestricted gift to the University of Miami in support of the CADE-21 Workshop on Empirically Successful Automated Reasoning in Large Theories, Microsoft Research.
Geoff Sutcliffe (host), Josef Urban (researcher), Euro 176076, Automating Reasoning in Large Formal Mathematical Knowledge Bases, European Union Marie Curie Outgoing International Fellowship.

Please see Curriculum Vitae for details.

## 4.3 External Funding

Having Ph.D. students and obtaining external funding are corequisites. We expect both to increase as the Department grows. According to Table 24-2 from the 2004-2005 and 2005-2006 Taulbee Survey, mean expenditure from external sources per tenure-track faculty is above $100,000 per year even for universities ranked below the top 36. The lion's share of this money goes to support Ph.D. students.

**NOTE**: The program is *not* dependent on external funding to get started. With seven teaching assistantships available, we can afford to provide each faculty member with a Ph.D. student to work with. This is enough for a good faculty member to "bootstrap" to an externally funded research program.

## 4.4 Equipment

The College of Arts and Sciences recently committed resources to a significant equipment upgrade:

- One classroom lab with 20 UNIX workstations, instructor's workstation, projector, and screen.
- One research/learning lab with 6 UNIX Workstations and 6 Windows PCs.
- Machine room housing servers and network equipment for the labs, faculty email, and the departmental web page and a firewall.
- Desktop PC, bootable in UNIX or Windows, for each teaching assistant.
- Computational cluster with 12 processors and 2 servers.

In addition to the general labs available to students, the Department already has an equipped lab with several machines and accessories for multimedia research and development.

The Department provides a desktop computer to each fellowship recipient.

## 4.5 Information Resources

The Department has sufficient access to resources through the University's Richter Library and online resources. The library's holdings are also expected to expand as new faculty with new areas of interest join the Department. The Department has an additional $7,000 annual budget with the library to purchase any materials not automatically acquired by the library.

In addition, many relevant journals and other resources are easily available online through the library's online subscriptions to publishers such as IEEE and the ACM digital library. This is extremely important in the Computer Science field, as most current research is being made available online quicker and more cost effectively than in printed format.

Section 4.6 lists the current Computer Science journal holdings at the library.

## 4.6 Journal Title Holdings

The following is a list of the current journal title holdings for Computer Science at the University of Miami's Richter Library:

A & I and Society
ACM Journal of Computer Documentation
ACM Letters on Programming Languages and Systems
ACM Sigplan Notices
ACM Transactions on Computational Logic
ACM Transactions on Computer Systems
ACM Transactions on Database Systems
ACM Transactions on Human Computer Interaction
ACM Transactions on Mathematical Software
ACM Transactions on Modeling and Computer Simulation
ACM Transactions on Programming Languages and Systems
ACM Transactions on Software Engineering and Methodology
Acta Informatica
AI Magazine
Algorithmica
Annals of Mathematics and AI
Applied Mathematics and Computation
Artificial Intelligence
BIT
BYTE
Combinatorics, Probability and Computing
Communications of the ACM
Computational Complexity
Computational Intelligence
Computer
Computer Aided Geometric Design
Computer Architecture News
Computer Communication
Computer Design
Computer Journal
Computer Languages
Computers and Mathematics with Applications
Computers and Security
Computing
Cybernetics
Database Programming
Distributed Computing
Expert Systems
Formal Aspects of Computing
Fundamenta Informaticae
Future Generation Computer Systems
Fuzzy Sets and Systems
IEEE Concurrency
IEEE Internet Computing
IEEE Micro - Chips, Systems, Software and Applications
IEEE Multimedia
IEEE Software
IEEE Transactions on Multimedia
IEEE Transactions of Information Theory
IEEE Transactions on Evolutionary Computation
IEEE Transactions on Fuzzy Systems
IEEE Transactions on Knowledge and Data Engineering
IEEE Transactions on Neural Networks
IEEE Transactions on Parallel and Distributed Systems
IEEE Transactions on Pattern Analysis and Machine Intelligence
IEEE Transactions on Software Engineering
IEEE Transactions on Systems, Man and Cybernetics ; Part A and B
Information and Computation
Information Processing Letters
Information Systems Research
Interacting With Computers
International Journal of Computational Geometry and Applications
International Journal of Foundations of Computer Science
International Journal of Human Computer Interaction
International Journal of Parallel Programming
International Journal of Systems Science
Journal of Algorithms
Journal of Automated Reasoning
Journal of Computation and Applied Mathematics
Journal of Computational Analysis
Journal of Computer and System Sciences
Journal of Computer Information Systems
Journal of Cryptology
Journal of Database Management
Journal of End-User Computing
Journal of Functional Programming
Journal of Logic and Computation
Journal of Logic Programming
Journal of Network and Computer Applications
Journal of Object Oriented Programming
Journal of Parallel and Distributed Computing
Journal of Scientific Computing
Journal of System Architecture
Journal of Systems and Software
Journal of Systems Architecture
Journal of the ACM
Journal of Visual Languages and Computing
Knowledge and Information Systems
Knowledge Based Systems
Linux Journal
Mathematical and Computer Modeling
Mathematical Programming
Mathematical Structures in Computer Science
Mathematics and Computer Education
Mathematics and Computers in Simulation
Mathematics of Computation
Microcomputer Applications
Multimedia Systems
Network: Computation in Neural Systems
Neural Computing and Applications
Neural Networks
Parallel Computing
Parallel Processing Letters
Pattern Recognition
Problems of Information Transmission
Programming and Computer Software
Random Structures and Algorithms
SIAM Journal on Computing
SIAM Journal on Scientific Computing
SIGMOD Record
Soft Computing
Software Concepts and Tools
Software Engineering Notes
Software Practice and Experience
Software Testing, Verification and Reliability
Systems and Control Letters
Theoretical Computer Science
Unix Review
Virtual Reality
Visual Computer
VLDB International Journal on Very Large Databases

# 5 Graduate Faculty

## Dr. Huseyin Kocak, Professor and Chairman

Ph.D. in Mathematics, 1980, University of California at Santa Cruz.
**Research Interests:** Dynamical Systems and their applications to biology, ecology and medicine; Scientific Computing, Visualization.
**Students:** Huseyin has advised and/or served on the committees of several dozen Master's and Doctoral students from The College of Arts and Sciences, School of Engineering, School of Atmospheric and Marine Sciences, and the former School of International Studies. Currently, he is advising an interdisciplinary Ph.D. thesis in Computer Science of McKnight Fellow Morgan Johnson and the Master's Thesis of Craig Kolthoff of the IT department.

## Dr. Thomas LeBlanc, Professor Executive Vice President and Provost

Thomas J. LeBlanc, executive vice president and provost, was appointed in 2005. He is the chief academic officer and chief budget officer for the University and is responsible for overseeing and coordinating academic programs and enhancing the educational mission of the University. He is also a professor in the Departments of Computer Science and Electrical and Computer Engineering. Previously, LeBlanc served as dean of the college faculty in the College of Arts, Sciences, and Engineering at the University of Rochester. His publications include writings on operating systems, parallel programming, and software engineering. He holds a Ph.D. and a master's degree in Computer Science from the University of Wisconsin at Madison and a Bachelor of Science in Computer Science from State University of New York at Plattsburgh [http://www6.miami.edu/UMH/CDA/UMH_Main/0,1770,2472-1;46573-3,00.html].

## Dr. Victor Milenkovic, Professor

Ph.D., 1988, Carnegie Mellon University.
**Research Interests:** Computational Geometry, Layout, Graphics, Numerical Issues, Computational Chemistry.
**Students:** Victor has graduated two Computer Science Ph.D. students at Harvard University, one of whom, Karen Daniels, is now a tenured associate professor, and one interdepartmental Ph.D. students at UM: Harald Schmidl. He has advised and served on the committees of numerous master's degree students. He is currently advising and funding interdepartmental PhD. student Steven Trac on an NSF grant and hopes to transition Steven to the new Ph.D. program.

## Dr. Shahriar Negahdaripour, Secondary Appointment, Professor of Electrical and Computer Engineering

Ph.D. Electrical Engineering, 1987, MIT.
**Research Interests:** Underwater Vision and Imaging.
**Active Projects:** 1) Integrated high-precision opti-acoustic imaging and positioning platform for underwater search and inspection, ONR DURIP, June'06- June'07. 2) Investigation of Multiple-View 3-D Reconstruction Methods with FS Sonar Video Cameras ONR, June'05- April'08.

## Dr. Mitsunori Ogihara, Professor

Ph.D. Information Technology, 1993, Tokyo Institute of Technology.
**Research Interests:** Computational Complexity, Molecular Computation, Data-Mining, Bioinformatics.
**Students:** Alina Beygelzimer (PhD: 2003), Yin-He Cheng (PhD: 2004), Gabriel Istrate (PhD: 1999), Ashwin Lall (expected defense: May, 2008), Tao Li (PhD: 2004), Srinivasan Parthasarathy (PhD: 1999), Bin Wei (expected defense: May, 2010). Mohammed Javeed Zaki (PhD: 1998), Chengliang Zhang (expected defense: July, 2007).

## Dimitris Papamichail, Assistant Professor

Ph.D., 2007, SUNY at Stony Brook.
**Research Interests:** Bioinformatics, algorithms and data structures, optimization, decision support systems.

## Dr. Victor Pestien, Secondary Appointment, Associate Professor of Mathematics

Ph.D. Mathematics, 1980, University of California at Berkeley.
**Research Interests:** Probability, Optimization.
**Students** (Ph.D., Mathematics): Michael G. Monticino, "The adequacy of measurable and of stationary strategies for approximating optimal return", Mathematics and Computer Science, University of Miami, May, 1987. Xiaobo Wang, "Reward functions and Markov strategies in finite-stage stochastic decision problems", Mathematics and Computer Science, University of Miami, July, 1992. Kevin R. Ruth, "Favorable red and black on the integers with a minimum wager9', Mathematics and Computer Science, University of Miami, December, 1999.

## Dr. Subramanian Ramakrishnan, Secondary Appointment, Associate Professor of Mathematics

Ph.D. Mathematics, 1980, Indian Statistical Institute
**Research Interests:** Probability, Statistics.
**Students** (Mathematics): Carlos Canas, DA project, Queueing Networks in Discrete-time: Exact results and Approximations, 2004. 2) John Beam, Ph.D. thesis, Expectations for Coherent probabilities, 2002.

## Dr. Burton Rosenberg, Associate Professor and Director of Technology

Ph.D., 1991, Princeton University.
**Research Interests:** Cryptography and security; scientific visualization and computation; mathematical finance.
**Students:** Launched webmail project with undergraduate Matt Mankins. Eventually sold as emumail, www.emumail.com. Advised one master's student, served on the committee for six other master students.

## Dr. Dilip Sarkar, Associate Professor and Director of Graduate Studies

Ph.D., 1988, University of Central Florida.
**Research Interests:** High-speed Networks, Mobile and Wireless Computing, Multimedia Communication and Systems, QoS on the Web
**Students:** Dilip is supervising two interdisciplinary Ph.D. students at UM: Wing Tong and Wei Zhou. He is also advising three master's students. In the past, Dilip has advised 25 master's degree students and served on the committees for several master's and Ph.D. degree students.

## Dr. Geoff Sutcliffe, Associate Professor and Director of Undergraduate Studies

Ph.D., 1992, The University of Western Australia.
**Research Interests:** Automated Theorem Proving (ATP), Evaluation of ATP Systems, Distributed and Parallel ATP
**Students:**
2005-2006 MS Supervisor, Shen W., Automated Proofs of Relationships Between Modal Logic Systems, University of Miami.
2004-2006 MS Supervisor, Moynihan K., Lascaux - An Intelligent Artistic Agent, University of Miami.
2003-2005 MS Supervisor, Zhang Y., The Use of Lemmas for Solving Hard Automated Theorem Proving Problems, University of Miami.

2003-2004 MS Supervisor, Gao Y., Automated Generation of Interesting Theorems, University of Miami.

1998-2003 MSc Supervisor, Brown M., Semantic Guidance for Linear ATP Systems, James Cook University.

1994 MSc Supervisor, Nugroho L., A Programmer's Tool for Managing Persistent Object Structures, James Cook University.

1990 MAppSc Supervisor, Tabada W., An Analysis and Implementation of Linear Derivation Strategies, Edith Cowan University.

# 6 Bulletin Description

This is the proposed bulletin description for the Ph.D. program.

## Doctor of Philosophy in Computer Science

The following requirements are in addition to the general requirements for the Doctor of Philosophy Degree as described by the Graduate School. The Computer Science Graduate Committee (CSGC) maintains full authority over all decisions pertaining to a Ph.D. student.

1. **Admission Requirements:** In order to be admitted to the Ph.D. program in Computer Science, an applicant must have obtained a minimum of 15 credits in Computer Science courses numbered 200 and above. Applicants may be admitted with deficiencies; these must be completed in addition to the degree requirements.

2. **Written Qualifying Exam:** The student must pass a three-hour written exam of general knowledge of Computer Science at the end of the first year. Upon failure, the student may petition the CSGC to allow a second attempt at the end of the second year.

   The exam will be administered once a year in the early weeks of the summer session. It will cover expected knowledge of all first-year graduate students. Included in this material are a fundamental understanding of algorithm analysis and design, advanced skills in programming, basic knowledge of computer architecture, and a general understanding of computer systems.

3. **Classroom Course Requirements:** In the first two years, the student must take eight CSGC-approved classroom courses, for a total of 24 credits. At least four of these courses (12 credits) must be at the 600 level. The eight courses must include two courses from each of the areas of Analysis, Applications, and Systems. The student should work with his or her advisor to select a cohesive set of courses as approved by the CSGC.

   The CSGC will have sole authority in designating the areas to which each course belongs. In the case that a course is designated in more than one area, a student may apply the course to only one area. The designation of current CSGC-approved courses appears at the end of this description.

4. **Project Course Requirements:** By the end of the second year the student must complete two graduate level project courses for a minimum total of 6 credits. Each project shall be under the supervision of a *different* faculty member in the Department.

   All Ph.D. students must find faculty willing to supervise their project in the semester preceding the project. The deadline for finding a supervisor shall be the first full week in April or November for the Fall and Spring terms, respectively. This deadline does not require identifying a specific project but only finding a faculty member willing to supervise a project.

Upon completion of a project, the student must write a detailed project report. This report shall become a public document and shall be kept on file by the Department. The student must present the finished project to a quorum of the CSGC at a time to be approved by the chairman of the Department. The supervisor and CSGC must approve each project as applicable toward candidacy for a Ph.D. A primary factor in determining approval shall be the stated willingness of the supervisor to become an initial Ph.D. advisor for the student.

5. **Annual Presentations:** After passing the written qualifying exam, the student must make a public oral presentation to the Department at least once per year. These presentations include the two project presentations, the thesis proposal, and the thesis defense. The goals are to develop the student's oral and presentation skills, to provide a means for the Department to check the research and progress of the student, and to present the opportunity for feedback to improve the student's research.

6. **Teaching Experience:** Each student must teach a lab-based course for a minimum of one semester. Lab-based courses typically require the student to present material in a relaxed lecture format, re-emphasizing material learned in the general lecture as well as introducing new material to the students.

## Approved Course Categories

The following is a list of approved courses for each of the three categories:

### Analysis

| | |
|---|---|
| CSC 506 | Logic |
| CSC 517 | Data Structures and Algorithm Analysis |
| CSC 518 | Compiler Theory |
| CSC 519 | Programming Languages |
| CSC 527 | Theory of Computing |
| CSC 531 | Introduction to Software Engineering |
| CSC 540 | Algorithm Design and Analysis |
| CSC 545 | Introduction to Artificial Intelligence |
| CSC 606 | Logic Programming |
| CSC 609 | Cryptography and Data Security |
| CSC 611 | Theory of Computation |
| CSC 612 | Theory of Complexity |
| CSC 623 | Theory of Relational Databases |
| CSC 628 | Parallel Algorithms |
| CSC 646 | Neural Computing |
| CSC 647 | Computational Geometry |
| EEN 656 | Information Theory |
| EEN 634 | Modeling and Analysis of Computer Networks |
| MTH 509 | Discrete Mathematics II |
| MTH 520 | Numerical Analysis I |
| MTH 521 | Numerical Analysis II |
| MTH 528 | Combinatorics |

### Applications

| | |
|---|---|
| CSC 523 | Principles of Filing and Database Systems |
| CSC 529 | Introduction to Computer Graphics |
| CSC 545 | Introduction to Artificial Intelligence |
| CSC 555 | Multimedia Systems |
| CSC 628 | Parallel Algorithms |
| CSC 645 | Expert System Design |
| CSC 646 | Neural Computing |
| CSC 648 | Automated Reasoning |
| CSC 655 | Advanced Multimedia Systems |
| EEN 638 | Computer Vision |
| MTH 520 | Numerical Analysis I |
| MTH 521 | Numerical Analysis II |

## Systems

| | |
|---|---|
| CSC 518 | Compiler Theory |
| CSC 519 | Programming Languages |
| CSC 521 | Principles of Computer Operating Systems |
| CSC 523 | Principles of Filing and Database Systems |
| CSC 524 | Networks and Information Security |
| CSC 555 | Multimedia Systems |
| CSC 609 | Cryptography and Data Security |
| CSC 645 | Expert System Design |
| CSC 655 | Advanced Multimedia Systems |
| EEN 514 | Computer Architecture |
| EEN 614 | Advanced Computer Architecture |
| EEN 534 | Computer Communication Networks |
| EEN 634 | Modeling and Analysis of Computer Networks |

# 7 Questions and Answers

Q: Are the courses in place to offer a Ph.D. and are they being taught?
A: Yes and yes. Our master's program is unashamedly research-oriented and we graduate many master's students each year, many of whom write master's theses that are published in journals. No new courses are planned for the Ph.D. program, nor do we plan to change the frequency. Section 8 provides data on the number of master's degrees bestowed in the past five years. Section 8 also provides data on past and planned future course offerings at the undergraduate and graduate level.

Q: How will we support the new Ph.D. students?
A: The department is able to award seven teaching assistantships to highly qualified students. Currently, we can only offer these to master's students. Obviously, we will also seek funding from outside the university for research assistantships. There is a shortage of Ph.D.s in Computer Science, and there is much external funding available for graduate work.

Q: What about the $100,000/year/faculty external funding?
A: A mature, successful Ph.D. program is *necessary* to reach this national average, but it is not necessarily *sufficient*. It is mere speculation that we will ever reach this level of external funding. *Instead,* this proposal is based solidly on past performance and current resources.

Q: Won't the number of master's students decrease as a result of shifting the resources?
A: Possibly but gradually: we plan to be very selective in the admission of Ph.D. students, leaving the remaining teaching assistantships for highly qualified master's students as before.

Q: Shouldn't we hire a few more faculty before establishing a Ph.D. program?
A: By requiring that student do research projects with two different faculty for candidacy, the new program is specifically designed to avoid "orphaning". Furthermore, with an established record of assigning teaching assistantships to master's students, we can afford to offer assistantships only to those Ph.D. applicants whose interests closely fit those of the faculty. Since a significant portion of potential *faculty* applicants will eschew a university without a Ph.D. program, perhaps the question should be, "Shouldn't we establish a Ph.D. program before hiring more faculty?"

Q: Won't the new Ph.D. program steal faculty time away from the undergraduates?
A: Again, quite the opposite: the *lack* of a Ph.D. program steals time from the undergraduate program. Given the universality of Ph.D. programs at research institutions, our faculty are expected to have a certain level of productivity in order to obtain grants and promotions. With a master's student, a faculty member has to spend much time and effort getting the student up to speed only to generate perhaps one joint paper. A Ph.D. student requires hardly more effort and leads to a much longer and more fruitful collaboration. So basically, the lack of a Ph.D. program means that faculty have to take time away from undergraduates in order to train graduate students.

Q: How does this program relate to those provided by the universities listed in Section 8?
A: For the most part, the program follows that of Johns Hopkins, also a young department. It

Table 1: Comparison of proposed program with several AAU universities. JHU=The Johns Hopkins University; UNC=The University of North Carolina at Chapel Hill; UFL=University of Florida, Gainesville.

| | UM | JHU | Duke | UNC | UFL |
|---|---|---|---|---|---|
| concentration courses | 2 | 2 | 4 | 3 | 4 |
| breadth courses | 6 | 6 | 4 | 6 | 6 |
| project courses | 2 | 2 | 0 | 0 | 0 |
| annual presentations | yes | yes | no | no | no |
| attend colloquia | no | yes | no | yes | yes |
| teaching | yes | yes | no | no | yes |
| written qualifier | yes | no | yes | yes | yes |
| oral qualifier | no | yes | no | yes | no |

requires courses in three areas–Analysis, Applications, and Systems–and it requires projects with two different faculty members. Table 7 compares the proposed program to Ph.D. programs at JHU and other nearby AAU universities. We note that many departments require attendance at colloquia. The Computer Science Department currently requires graduate students to attend as a condition of receiving a teaching assistantship.

# 8 Additional Supporting Materials

1. Approval of College of Arts and Sciences, November 16, 2004.
2. Total number of MS degrees awarded in the last five years.
3. Undergraduate and graduate teaching of computer science courses: 1994-2000.
4. Undergraduate and graduate teaching of computer science courses: 2000-2007 (anticipated).
5. CV: Huseyin Kocak
6. CV: Thomas LeBlanc
7. CV: Victor J. Milenkovic.
8. CV: Shahriar Negahdaripour
9. CV: Mitsunori Ogihara
10. CV: Dimitris Papamichail
11. CV: Victor Pestien
12. CV: Subramanian Ramakrishnan
13. CV: Burton Rosenberg.
14. CV: Dilip Sarkar.
15. CV: Geoff Sutcliffe.
16. 2005-2006 CRA Taulbee Survey.
17. 2004-2005 CRA Taulbee Survey.
18. 2001-2002 Industry Salary Survey
19. CRA Forsythe List of Ph.D.-granting departments.
20. List of Florida Ph.D.-granting departments.
21. Johns Hopkins University (CS Dept), Program for Ph.D. students.
22. Duke University (CS Dept), Program for Ph.D. students.
23. University of North Carolina (CS Dept), Program for Ph.D. students.
24. University of Florida (CS Dept), Program for Ph.D. students.

25. Graduate Education in Computational Science and Engineering. *SIAM Review*, Volume 43, Number 1, pp. 163-177.

26. Proposal to the Faculty Senate to establish a new Department of Computer Science, approved January 1999.

UNIVERSITY OF Miami

**MEMORANDUM**

March 10, 2008

TO: Faculty Senate

FROM: Hüseyin Koçak
Chair, Department of Computer Science

SUBJECT: Ph.D. Program in Computer Science

This memo serves to confirm that the Department of Computer Sciences faculty unanimously approved the Ph.D. Program in Computer Science. The proposal is now forwarded to the Faculty Senate for action. No additional funds are being requested for the successful implementation of the proposed Ph.D. program in Computer Science.

Department of Computer Science
College of Arts & Sciences
P.O. Box 248154
Coral Gables, Florida 33124-4245
305-284-2268
Fax: 305-284-2264

## Faculty Senate Office

**From:** Faculty Senate Office
**Sent:** Monday, April 07, 2008 3:11 PM
**To:** Kocak, Huseyin
**Cc:** Garcia, Julieta
**Subject:** legislation approved by the PResident

Below is a link to your copy of legislation that has been approved by the President:

Legislation # 2007-40(B)- College of Arts and Science Establishment of a Doctor of Philosophy (PhD) in Computer Science (This has been forwarded to the Board of Trustees for their approval)

Regards,

Robyn

Faculty Senate Office
University of Miami
325 Ashe Administration Building
1252 Memorial Drive
Coral Gables, FL 33146
(305) 284-3721
Fax: (305) 284-5515
www.miami.edu/fs

## Faculty Senate Office

**From:** Faculty Senate Office
**Sent:** Monday, April 07, 2008 2:47 PM
**To:** Freyre, Maria Beatriz
**Subject:** Your copy of approved legislation

Hi Betty,
Below are links to Dr. Birnbach's copies of Legislation that has been approved by the President:

Legislation # 2007-39(B)- Miami Institute for Human Genomics (MHIG) at the Miller School of Medicine

Legislation # 2007-40(B)- College of Arts and Science Establishment of a Doctor of Philosophy (PhD) in Computer Science

Legislation # 2007-41(B) - School of Architecture Establishment of a Master Degree in Real Estate Development and Urbanism ( MRED& U)

Legislation # 2007-43 (B)- Move of the Master of Public Administration from the School of Business Administration to the College of Arts & Sciences

Thanks,

Robyn

Faculty Senate Office
University of Miami
325 Ashe Administration Building
1252 Memorial Drive
Coral Gables, FL 33146
(305) 284-3721
Fax: (305) 284-5515
www.miami.edu/fs

## Faculty Senate Office

**From:** Faculty Senate Office
**Sent:** Monday, April 07, 2008 3:09 PM
**To:** Halleran, Michael Ros
**Cc:** Glemaud, Rose-Ketlie
**Subject:** legislation approved by the President

Attached are your copies of legislation that has been approved by the President:

Legislation # 2007-40(B)- College of Arts and Science Establishment of a Doctor of Philosophy (PhD) in Computer Science (This has been forwarded to the Board of Trustees for their approval)

Legislation # 2007-43 (B)- Move of the Master of Public Administration from the School of Business Administration to the College of Arts & Sciences

Regards,

Robyn

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325 Ashe Administration Building
1252 Memorial Drive
Coral Gables, FL 33146
(305) 284-3721
Fax: (305) 284-5515
www.miami.edu/fs

## Faculty Senate Office

**From:** Faculty Senate Office
**Sent:** Monday, April 07, 2008 2:57 PM
**To:** Scandura, Teresa Anne
**Cc:** Rowand, Michele M
**Subject:** approved legislation

Attached are the links to your copies of legislation that has been approved by the President:

Legislation # 2007-40(B)- College of Arts and Science Establishment of a Doctor of Philosophy (PhD) in Computer Science (this has been forwarded to the Board of Trustees for their approval)

Legislation # 2007-41(B) - School of Architecture Establishment of a Master Degree in Real Estate Development and Urbanism ( MRED& U) (this has been forwarded to the Board of Trustees for their approval)

Legislation # 2007-43 (B)- Move of the Master of Public Administration from the School of Business Administration to the College of Arts & Sciences

Thanks,

Robyn

Faculty Senate Office
University of Miami
325 Ashe Administration Building
1252 Memorial Drive
Coral Gables, FL 33146
(305) 284-3721
Fax: (305) 284-5515
www.miami.edu/fs

## Faculty Senate Office

**From:** Faculty Senate Office
**Sent:** Tuesday, April 01, 2008 6:05 PM
**To:** Glemaud, Rose-Ketlie
**Subject:** FW: Legislation #2007-40(B)
**Attachments:** 2007-40B.pdf

Forgot to cc you,
Sorry,
Robyn

Faculty Sentate Office
University of Miami
325 Ashe Administration Building
1252 Memorial Drive
Coral Gables, FL 33146
(305) 284-3721
Fax: (305) 284-5515
www.miami.edu/fs

-----Original Message-----
From: Faculty Senate Office
Sent: Tuesday, April 01, 2008 3:57 PM
To: Birnbach, David J; Halleran, Michael Ros; Scandura, Teresa Anne; Kocak, Huseyin
Cc: Garcia, Julieta
Subject: Legislation #2007-40(B)

Attached is your copy of Legislation 2007-40(B) - College of Arts and Science Establishment of a Doctor of Philosophy (PhD) in Computer Science which is pending based on approval by the President. You will be sent a copy of the legislation once it has been approved by the President and the Board of Trustees.

Regards,
Robyn Hardeman

Faculty Sentate Office
University of Miami
325 Ashe Administration Building
1252 Memorial Drive
Coral Gables, FL 33146
(305) 284-3721
Fax: (305) 284-5515
www.miami.edu/fs

UNIVERSITY OF Miami
FACULTY SENATE

# MEMORANDUM

**To:** Donna E. Shalala
President

**From:** Stephen Sapp
Chair, Faculty Senate

**Date:** March 31, 2008

**Subject:** Faculty Senate Legislation #2007-40(B) – College of Arts and Science Establishment of a Doctor of Philosophy (PhD) in Computer Science

**********

The Faculty Senate, at its March 26, 2008 meeting, voted unanimously to approve the College of Arts and Science establishment of a Doctor of Philosophy in Computer Science.

The proposal is enclosed for your reference.

This legislation is now forwarded to you for your action.

SS/rh

Enclosure

cc: Thomas LeBlanc, Executive Vice President and Provost
David J. Birnbach, Vice Provost for University Administration and Faculty Affairs
Michael Halleran, Dean, College Arts and Science
Teresa Scandura, Dean, Graduate School
Huseyin Kocak, Proposal presenter, Professor, Department of Computer Science

[Please contact the Senate office to view this proposal.]

Faculty Senate
1252 Memorial Drive, 325 Ashe Admin. Bldg.
Coral Gables, Florida 33124
Phone: (305) 284-3721 • Fax: (305) 284-5515
http://www.miami.edu/FacultySenate
email: facsen@miami.edu

Faculty Senate Legislation #2007-39(B) – College of Arts and Science establishment of a Doctor of Philosophy in Computer Science

## PRESIDENT'S RESPONSE

APPROVED: _____ DATE: 4/7/08
(President's Signature)

OFFICE OR INDIVIDUAL TO IMPLEMENT: DEAN MICHAEL HALLERAN

EFFECTIVE DATE OF LEGISLATION: _____
(if other than June 1 next following)

NOT APPROVED AND REFERRED TO: _____

REMARKS (IF NOT APPROVED): _____

UNIVERSITY OF Miami
FACULTY SENATE

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**To:** Donna E. Shalala
President

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Chair, Faculty Senate

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" Huseyin Kocak, Proposal presenter, Professor, Department of Computer Science

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UNIVERSITY OF Miami

FACULTY SENATE

# MEMORANDUM

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President

**From:** Stephen Sapp
Chair, Faculty Senate

**Date:** March 31, 2008

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SS/rh

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email: facsen@miami.edu

Faculty Senate Legislation #2007-39(B) – College of Arts and Science establishment of a Doctor of Philosophy in Computer Science

## PRESIDENT'S RESPONSE

APPROVED: _____ DATE: 4/7/08
(President's Signature)

OFFICE OR INDIVIDUAL TO IMPLEMENT: DEAN MICHAEL HALLERAN

EFFECTIVE DATE OF LEGISLATION: _____
(if other than June 1 next following)

NOT APPROVED AND REFERRED TO: _____

REMARKS (IF NOT APPROVED): _____

# FACULTY SENATE MEETING AGENDA
## BankUnited Center, Hurricane 100 Room
## March 26, 2008 – 3:30 p.m.

For all items except B4 CLICK HERE
For Item B4 CLICK HERE

| | | | Approx. Time |
|---|---|---|---|
| **A.** | | **Introductory Matters** | |
| | A1. | # Chair's remarks | 3:30 |
| | A2. | President's remarks | 3:35 |
| | A3. | Approval of today's agenda | 4:00 |
| | A4. | # Approval of minutes of February 27, 2008 | 4:05 |
| | A5. | Other announcements | 4:10 |
| **B.** | | **General Matters** | |
| | B1. | Introduction of Sheri A. Keitz, M.D., Ph.D., Associate dean for Faculty Diversity and Development, Miller School of Medicine, Chief, Medical Service, Miami VA Healthcare System – S. Hayes | 4:15 |
| | B2. | * Miami Institute for Human Genomics and Component Center Proposals – J. McCafferty-Cepero | 4:30 |
| | B3. | * Proposal for a Doctor of Philosophy in Computer Science – H. Kocak | 4:45 |
| | B4. | * Proposal for a New Degree Program; the Master in Real Estate Development and Urbanism (MRED&U) – E. Plater-Zyberk, C. Bohl | 5:10 |
| | B5. | * Academic Standards Committee Undergraduate Admission Report – S. Cantrell | 5:35 |
| | B6. | # Move of Master of Public Administration from the School of Business Administration to the College of Arts and Sciences – S. Hayes | 6:00 |
| | B7. | # Senate Apportionment – S. Hayes | 6:05 |
| | B8. | Election of Nominating Committee – S. Hayes | 6:15 |
| **C.** | | **Other Business** | |
| **D.** | | **Executive Session** | |
| | D1. | Selection of the Outstanding Teaching Award recipient | 6:20 |
| **E.** | | **Adjournment** | |

# related material
* These materials are not for public viewing and will not be posted on the Faculty Senate website.

# A Proposal for a New Degree Program
# Doctor of Philosophy in Computer Science

Unanimously Approved by College of Arts and Science, November 16, 2004

Unanimously approved by the Graduate Council, October 27, 2007

Revised: March 22, 2008 *

Department of Computer Science
College of Arts and Sciences
University of Miami

FINAL 4
FACULTY
SENATE
COPY

*Clarifications have been made at the request of the Faculty Senate General Welfare Committee. No changes have been made to requirements of program.

# Contents

# 1 Introduction

## 1.1 The Field of Computer Science

Computer science is the systematic study of computation. The fundamental building blocks of the field are algorithms, the descriptions of computational processes in terms of well-defined instructions. Algorithms capture underlying ideas behind computation and enable conversations among scientists without having to use specific programming languages. While the concept of algorithms has existed for more than two millennia, it is only in the later part of the last century that the first academic computer science departments were created. Despite its infancy, however, the field of computer science has grown at a remarkable speed and has now acquired a prominent position in academic institutions, both in the states and in other modern countries. The growth is in part due to the rapid advancements in computer technologies, as observed in the so-called Moore's law, which states that the density of transistors on computer chips doubles every eighteen months. However, what truly propelled the growth are the ingenious concepts and earth-shaking algorithms produced by computer scientists, which have made computing more interesting, more effective, and more accessible. Such ideas include computer graphics, email, object-oriented programming, public-key cryptography, sorting, string matching, virtual reality, and world-wide web. The influence of those revolutionary ideas have gone very far beyond the boundary of computer science. Computing has become not only a central tool for many fields of natural sciences, engineering, social sciences, business, medicine and arts but an essential part of human life. This unprecedented ubiquity puts computer science in a very unique position in academe and makes it one of the most important, if not the most important, disciplines of the 21st century.

Critical missions of any scholastic discipline are research and education, and in many disciplines the two missions are intricately related with each other. This is certainly the case for computer science. In most research areas of computer science, investigations are through experimentation involving complex computer programs. Academic computer scientists can therefore speed up substantially their research investigations by teaming up with graduate students that understand and implement underlying scientific ideas. This partnership between the advisers and the advisees are mutually beneficial. While the gain of speed allows the researchers to produce more results, the graduate students receive critical training through hands-on research experience. Since even the most advanced computing technologies of today may be become outdated tomorrow, graduate computer science training must instill in students universal research skills that stand the test of time.

## 1.2 The UM Computer Science Department

At the University of Miami, the Computer Science Department was created in 2000 out of the Mathematics Department, in part for the purpose of serving the growing demands of the UM undergraduate students to receive education in the field. The research expertise of the current Computer

Science tenure-track faculty touches upon a variety of key research areas: artificial intelligence, automated reasoning, bioinformatics, computational complexity, computational geometry, computer graphics, cryptography and security, data mining, large-scale modeling, molecular computation, multimedia systems, and network algorithms. The department currently has eight tenure-track faculty members (seven of them are tenured). The existing tenure-track faculty members received graduate training in the areas that have a strong focus on algorithms, i.e., the abstract ideas underlying computation. This makes them ideal for teaching students how to think creatively using standard methodologies as well as how to transfer ideas from one subject to another. The proximity of the Department to researchers in the University whose work heavily uses computation (those in the Departments of Biology, Chemistry, and Physics on the Coral Gables Campus and those in the Schools of Marine and Atmospheric Sciences and of Medicine) offers tremendous advantage for these researchers to engage in interdisciplinary collaboration with members of the Department. In fact, the Computer Science Department has a proven record of exploring such opportunities to produce excellent research outcomes, and of training students through such projects. The Department takes its pride in having sent both of its undergraduate and graduate students to top jobs, both in the mainstream computer science field and in interdisciplinary fields, such as bioinformatics.

The interdisciplinary research of the Department is expected to be strengthened further through its involvement with the recently created Center for Computational Sciences. The Center is expected to offer five core research programs, each led by a director having a tenure-track primary appointment. So far only one core program director has been recruited, and that director is primarily appointed in Computer Science. The rest of the program directors will be recruited in the next two years, and one or two of them are likely also to have appointments in Computer Science. Also, it is anticipated that many of the in-house Ph.D. researchers of the Center, who directly report to program directors, will have formal affiliations with the Department. The affiliation of the directors and the researchers gives a tremendous opportunity for the Department to extend its research horizon and widen its educational programs. The Department believes that by capitalizing this unique opportunity it will be able to boost its external research funding substantially, produce more high quality research, and enrich its educational programs, and thereby increase its visibility both within the University and in the national and international computing research communities.

## 1.3 The Purpose of This Document

Establishing a Ph.D. program will greatly speed up the research progress and make the Department significantly more productive and more visible. The Department hereby requests approval to establish such a program, with the goal of enrolling the first batch of students in the academic year of 2008-09.

The requested Ph.D. leverages the existing mature Master of Science program in Computer Science, which the Department inherited from the Mathematics program and which has been graduating

students since 1971. Since 1996, the Master of Science program has graduated 54 students[1]. The classroom courses taught for the Master of Science program (and in the Computer Engineering program) are sufficient for starting a Doctor of Philosophy program in Computer Science of minimum breadth. (See the table of Computer Science courses taught from 1994 to 2007 in Section 7.)

### 1.4 Outline of the Rest of the Document

Section 2 discusses the expected outcomes of the requested Ph.D. program. Section 3 provides the description of the new program, which closely follows the Ph.D. curriculum in computer science at several prominent universities. Section 3.5 presents the current categorized list of approved graduate-level courses. Section 4 describes the resources available to the students of the new program. Section 5 gives a short description of each graduate faculty member in the Department of Computer Science. Section 6 provides the text that should be added to the graduate bulletin. Section 7 answers some common questions about the proposal. Section 8 gives additional supporting material. Curriculum Vitae are attached.

## 2 Expected Outcomes

### 2.1 Interdisciplinary Ph.D. Programs

The March 2001 issue of the SIAM Review contains an article describing an influential program that mixes a graduate Computer Science curriculum with other science and engineering-oriented curricula. The article states, "Computational science and engineering (CSE) is a rapidly growing multidisciplinary area with connections to the sciences, engineering, mathematics, and computer science." The influence of Computer Science is strong in such fields as biology, chemistry, physics, medicine, and bioengineering. Many universities across the country have already established such interdisciplinary programs, in particular, establishing interdisciplinary programs in computational biology/bioinformatics has been a trend in the past few years. For example, the CSE Program at Purdue University "offers [MS and Ph.D.] specializations in computational science and computational engineering in 17 departments..." Although such an interdisciplinary program is certainly worth pursuing, before the University can create such a program it must have as a basis to cover the fundamentals, including a strong Ph.D. program in Computer Science.

### 2.2 Undergraduate and Graduate Relationships

Graduate teaching assistants, who currently are master's students, run course labs (for courses with a lab in addition to a lecture), grade homework, and monitor the teaching lab during non-class daytime hours, nights, and weekends, when the undergraduates work on their programming

[1] See Section 8

assignments. Since Ph.D. students will remain in the Department longer than master's students, they will have more time to gain research and teaching experience. This teaching experience will directly benefit the undergraduate Computer Science program and the undergraduate students in the University. For example, a Ph.D. student will have the opportunity to assist a greater variety of courses and thus is more likely to be able to answer a question posed by an undergraduate when the Ph.D. student is monitoring the teaching lab.

In addition to enhancing the current duties of teaching assistants, Ph.D. students will serve two new roles. First, Ph.D. students will help bridge faculty research to undergraduates. Second, Ph.D. students act as role models for undergraduates. Their influence will motivate talented undergraduates to pursue research and enter Ph.D. programs. Successful researchers generally remember their undergraduate years and the influence it had on their decision to pursue post-graduate studies.

One might think that a Ph.D. program would shift faculty time away from the undergraduate program, but quite the opposite is true: the *lack* of a Ph.D. program steals time from the undergraduate program. Given the universality of Ph.D. programs at research institutions, the Department faculty are expected to have a certain level of productivity in order to obtain grants and promotions. With a master's student, a faculty member has to spend much time and effort getting the student up to speed only to generate perhaps one joint paper. A Ph.D. student requires hardly more effort and leads to a much longer and more fruitful collaboration. The lack of a Ph.D. program means that faculty have to take time away from undergraduates in order to train graduate students.

## 2.3 Job Market Prospects

Computer Science graduates earn some of the highest salaries among all college-level graduates. The benefits of a Computer Science degree for an undergraduate are well understood. Having a Ph.D. in Computer Science presents further benefits. The tremendous amount of resources being devoted to information sciences ensures that a Ph.D. in Computer Science will remain a major asset for many years. Upon graduation, a Ph.D. student can expect to find numerous research jobs in both academia and industry.

According to the 2005-2006 Taulbee Survey, Table 4, 26.0% of Ph.D. recipients find employment in North American Ph.D.-granting departments: 12.8% tenure-track, 2.6% researcher, 8.9% postdoc, and 1.7% teaching faculty. 5.2% find positions in other CS/CE departments. 49.4% find jobs in industry and 2.5% in government. Only 0.7% were unemployed. According to Table 27, the mean and median salary for NTT faculty was above $62,000. The mean and median salary for assistant professors was above $84,000. According to the 2002 Industrial Salary Survey of CS Research Labs (the latest available), the mean and median salary for a new Ph.D. was above $99,000.

Clearly, the demand for qualified researchers in Computer Science is high, and the prospects of a Ph.D. graduate in Computer Science are good.

# 3 Description

## 3.1 Exact Title of Degree

DOCTOR OF PHILOSOPHY IN COMPUTER SCIENCE

## 3.2 Overview

To earn a Ph.D. in Computer Science, a student must satisfy all the general requirements for a Ph.D. set by the graduate school: standardized tests, grade point average, residency, minimum credit distributions, *etc.* The following requirements are those which are specific to the Computer Science program. The goal of this program is to provide the Ph.D. student with both overall *breadth* in the field and *depth* in a particular area of concentration. To that end, the curriculum is broken into several categories:

- **A written qualifying examination** demonstrating advanced general knowledge (breadth) in Computer Science.
- **Course requirements** covering material in many areas, strengthening breadth, and extra course work in one particular area, strengthening depth.
- **Two research projects** building depth of knowledge in a particular field, as well as strengthening relationships between faculty and students for possible dissertation work.
- **Thesis proposal and defense**, accompanied by an oral exam to demonstrate significant depth in the chosen field.
- **Annual presentations** to demonstrate depth of knowledge, strengthen presentation skills, and provide a means of overseeing the student's progress.
- **Teaching experience** to strengthen both the student's presentation skills and the ability to explain materials in a coherent manner.

A Ph.D. student successfully completing the requirements in all of these categories will have demonstrated significant knowledge and understanding of the field of Computer Science and shall be deemed ready to use that knowledge in the broader community.

## 3.3 Admission Requirements

In order to be admitted to the Ph.D. program in Computer Science, an applicant must meet all of the requirements set by the Graduate School including adequate scores on the GREs. In addition, a minimum of 15 credits in Computer Science courses at sophomore level and above is required. These courses in the computer science department at UM are numbered 200 and above. Students may be admitted with deficiencies; these must be completed in addition to the degree requirements.

## 3.4 Ph.D. Degree Requirements

Upon completion of the curriculum, the student will have earned at least 60 credit hours beyond that of a bachelor's degree. Minimally, 12 credits will have come from dissertation research, 6 credits from research projects, and 24 credits from classroom courses. However, a typical student will have earned 24 credits from dissertation research, 12 credits from research projects, and 24 credits from classroom courses. At least 30 credits must be open only to graduate students. These courses at UM are numbered 600 and above. The student must also have obtained a minimum of 24 credits while in residence at UM. The Computer Science Graduate Committee (CSGC) maintains full authority over all decisions pertaining to a Ph.D. student. In particular, the acceptance of credits transferred by the student from another post-graduate institution shall be determined by the CSGC.

As specified by the Graduate School, degree requirements must be completed within eight years of the time of admission to graduate work and within four years of passing the qualifying examination. A Computer Science Ph.D. student shall be deemed to have passed the qualifying examination process upon completion of the written qualification examination and the research project requirements.

What follows is a more in-depth description of the categories, detailing the various criteria the student is expected to meet.

### Written Qualifying Exam

Every Ph.D. student must pass a three hour written exam of general knowledge of Computer Science at the end of the first year. Upon failure, the student may petition the CSGC to allow a second attempt at the end of the second year.

The exam will be administered once a year in the early weeks of the summer session. It will cover expected knowledge of all first-year graduate students. Included in this material are a fundamental understanding of algorithm analysis and design, advanced skills in programming, basic knowledge of computer architecture, and a general understanding of computer systems.

### Classroom Course Requirements

In the first two years, the student must take eight CSGC-approved classroom courses, for a total of 24 credits. At least four of these courses (12 credits) must be open only to graduate students. These courses at UM are numbered 600 and above.

The eight courses must include two courses from each of the areas of Analysis, Applications, and Systems. The student should work with his or her advisor to select a cohesive set of courses as approved by the CSGC.

The CSGC will have sole authority in designating the areas to which each course belongs. In the case that a course is designated in more than one area, a student may apply the course to only one area. The designation of current CSGC-approved courses appears in Section 3.5.

### Project Course Requirements

By the end of the second year the student must complete two graduate level project courses for a minimum total of 6 credits. Each project shall be under the supervision of a *different* faculty member in the Department.

All Ph.D. students must find faculty willing to supervise their project in the semester preceding the project. The deadline for finding a supervisor shall be the first full week in April or November for the Fall and Spring terms, respectively. This deadline does not require identifying a specific project but only finding a faculty member willing to supervise a project.

Upon completion of a project, the student must write a detailed project report. This report shall become a public document and shall be kept on file by the Department. The student must present the finished project to a quorum of the CSGC at a time to be approved by the chairman of the Department. The supervisor and CSGC must approve each project as applicable toward candidacy for a Ph.D. A primary factor in determining approval shall be the stated willingness of the supervisor to become an initial Ph.D. advisor for the student.

### Dissertation Committee, Proposal, and Defense

Upon completion of the two projects, the CSGC shall appoint a Dissertation Committee for the student as required by the Graduate School. The student must present a thesis proposal by the end of the fourth year. Both proposal and defense will include a public oral presentation followed by questioning from the Dissertation Committee.

### Development of Presentation Skills

After passing the written qualifying exam, the student must make a public oral presentation to the Department at least once per year. These presentations include the two project presentations, the thesis proposal, and the thesis defense. The goals are to develop the student's oral and presentation skills, to provide a means for the Department to check the research and progress of the student, and to present the opportunity for feedback to improve the student's research.

### Teaching Experience

Since Ph.D. graduates should be qualified to work in academia, each student must teach a lab-based course for a minimum of one semester. Lab-based courses introduce the student to working

closely with both a faculty member and undergraduate students. These courses typically require the student to present material in a relaxed lecture format, re-emphasizing material learned in the general lecture as well as introducing new material to the students.

## 3.5 Approved Course Categories

The following is a list of approved courses for the classroom course requirements:

### Analysis

| | |
|---|---|
| CSC 506 | Logic |
| CSC 517 | Data Structures and Algorithm Analysis |
| CSC 518 | Compiler Theory |
| CSC 519 | Programming Languages |
| CSC 527 | Theory of Computing |
| CSC 531 | Introduction to Software Engineering |
| CSC 540 | Algorithm Design and Analysis |
| CSC 545 | Introduction to Artificial Intelligence |
| CSC 606 | Logic Programming |
| CSC 609 | Cryptography and Data Security |
| CSC 611 | Theory of Computation |
| CSC 612 | Theory of Complexity |
| CSC 623 | Theory of Relational Databases |
| CSC 628 | Parallel Algorithms |
| CSC 646 | Neural Computing |
| CSC 647 | Computational Geometry |
| EEN 634 | Modeling and Analysis of Computer Networks |
| EEN 656 | Information Theory |
| MTH 509 | Discrete Mathematics II |
| MTH 520 | Numerical Analysis I |
| MTH 521 | Numerical Analysis II |
| MTH 528 | Combinatorics |

### Applications

| | |
|---|---|
| CSC 523 | Principles of Filing and Database Systems |
| CSC 529 | Introduction to Computer Graphics |
| CSC 545 | Introduction to Artificial Intelligence |
| CSC 555 | Multimedia Systems |
| CSC 628 | Parallel Algorithms |
| CSC 645 | Expert System Design |
| CSC 646 | Neural Computing |
| CSC 648 | Automated Reasoning |
| CSC 655 | Advanced Multimedia Systems |
| EEN 577 | Data Mining |
| EEN 638 | Computer Vision |
| EEN 653 | Pattern Recognition and Neural Networks |
| MTH 520 | Numerical Analysis I |
| MTH 521 | Numerical Analysis II |

### Systems

| | |
|---|---|
| CSC 518 | Compiler Theory |
| CSC 519 | Programming Languages |
| CSC 521 | Principles of Computer Operating Systems |
| CSC 523 | Principles of Filing and Database Systems |
| CSC 524 | Networks and Information Security |
| CSC 555 | Multimedia Systems |
| CSC 609 | Cryptography and Data Security |
| CSC 645 | Expert System Design |
| CSC 655 | Advanced Multimedia Systems |
| EEN 514 | Computer Architecture |
| EEN 534 | Computer Communication Networks |
| EEN 614 | Advanced Computer Architecture |
| EEN 634 | Modeling and Analysis of Computer Networks |
| EEN 671 | Advanced Interactive Multimedia Information Systems |

## 3.6 Projected Program Size

Here is a conservative projected graduate program size. We plan to accept two Ph.D. students per year to reach a total of 10 students.

| year | 1st | 2nd | 3rd | 4th | 5th |
|---|---|---|---|---|---|
| M.S. | 16 | 15 | 14 | 13 | 12 |
| Ph.D. | 2 | 4 | 6 | 8 | 10 |
| Total | 18 | 19 | 20 | 21 | 22 |

As resources are diverted from the master's program to the Ph.D. program, the number of master's students may decrease, but the total number of graduate students will increase.

# 4 Resources

The Department of Computer Science already has the resources to support the research of its faculty, its Master of Science program, and a Ph.D. program.

## 4.1 Teaching Assistantships

The Department has an allocation of seven teaching assistantships. Interdisciplinary Ph.D. students currently associated with the Department are also supported by individual faculty research funds, the university fellowship program, and the McKnight Fellowship program. Given the diversity of funding available for graduate students in Computer Science, no additional allocation of teaching assistantships is required.

## 4.2 Current Funding

Huseyin Kocak, Burt Rosenberg, Brian Coomes (Mathematics), $299,000, NSF.
Huseyin Kocak, RSMAS (F. Beron-Vera, M. Brown, M. Olascoaga), $900,000, NSF.
Victor Milenkovic, $240,000, NSF.
Dilip Sarkar, $27,650, University of Miami Small Grant.
Geoff Sutcliffe, $20000, Unrestricted gift to the University of Miami in support of Research in Automated Reasoning, Articulate Software.
Geoff Sutcliffe (PI), Huseyin Kocak (co-PI), Burt Rosenberg (co-PI), Victor Pestien (co-PI) (Mathematics), $467575, Computer Science and Mathematics for Scientists, NSF Scholarships in Science, Technology, Engineering, and Mathematics.
Geoff Sutcliffe, $1500, Unrestricted gift to the University of Miami in support of the CADE-21 Workshop on Empirically Successful Automated Reasoning in Large Theories, Microsoft Research.
Geoff Sutcliffe (host), Josef Urban (researcher), Euro 176076, Automating Reasoning in Large Formal Mathematical Knowledge Bases, European Union Marie Curie Outgoing International Fellowship.

Please see Curriculum Vitae for details.

## 4.3 External Funding

Having Ph.D. students and obtaining external funding are corequisites. We expect both to increase as the Department grows. According to Table 24-2 from the 2004-2005 and 2005-2006 Taulbee Survey, mean expenditure from external sources per tenure-track faculty is above $100,000 per year even for universities ranked below the top 36. The lion's share of this money goes to support Ph.D. students.

NOTE: The program is *not* dependent on external funding to get started. With seven teaching assistantships available, we can afford to provide each faculty member with a Ph.D. student to work with. This is enough for a good faculty member to "bootstrap" to an externally funded research program.

## 4.4 Funding Mix

Table 25 of the 2005-2006 Taulbee survey (http://www.cra.org/CRN/articles/may07/tables24to26.html) indicates the following for US departments ranked higher than 36th. 54.5% of student funding comes from institutional support, with 36.2% being teaching assistantships. It follows that our initial goal of roughly half the students on teaching assistantships and half on external funding is not out of line and will not unduly hamper recruitment of good students in comparison to peer universities.

Table 42 of the 2005-2006 Taulbee survey (http://www.cra.org/CRN/articles/may07/tables39to44.html) gives external funding sources for departments ranked higher than 36th. The NSF provides 45.7% with defense a distant second. The bulk of our current funding comes from the NSF or the equivalent European agency. A small part comes from industry, but it is significant because it is much more flexible. Again, we are not out of line with similar universities, although we need to increase funding from other sources. We have a significant joint NSF project with RSMAS. With our focus on bioinformatics, we can hope for participation in an NIH project in the Medical school. Defense funding will be difficult to obtain until we are much larger.

## 4.5 Equipment

The College of Arts and Sciences recently committed resources to a significant equipment upgrade:

- One classroom lab with 20 UNIX workstations, instructor's workstation, projector, and screen.
- One research/learning lab with 6 UNIX Workstations and 6 Windows PCs.
- Machine room housing servers and network equipment for the labs, faculty email, and the departmental web page and a firewall.

- Desktop PC, bootable in UNIX or Windows, for each teaching assistant.
- Computational cluster with 12 processors and 2 servers.

In addition to the general labs available to students, the Department already has an equipped lab with several machines and accessories for multimedia research and development.

The Department provides a desktop computer to each fellowship recipient.

## 4.6 Information Resources

The Department has sufficient access to resources through the University's Richter Library and online resources. The library's holdings are also expected to expand as new faculty with new areas of interest join the Department. The Department has an additional $7,000 annual budget with the library to purchase any materials not automatically acquired by the library.

In addition, many relevant journals and other resources are easily available online through the library's online subscriptions to publishers such as IEEE and the ACM digital library. This is extremely important in the Computer Science field, as most current research is being made available online quicker and more cost effectively than in printed format.

Section 4.7 lists the current Computer Science journal holdings at the library.

## 4.7 Journal Title Holdings

The following is a list of the current journal title holdings for Computer Science at the University of Miami's Richter Library:

A & I and Society
ACM Journal of Computer Documentation
ACM Letters on Programming Languages and Systems
ACM Sigplan Notices
ACM Transactions on Computational Logic
ACM Transactions on Computer Systems
ACM Transactions on Database Systems
ACM Transactions on Human Computer Interaction
ACM Transactions on Mathematical Software
ACM Transactions on Modeling and Computer Simulation
ACM Transactions on Programming Languages and Systems
ACM Transactions on Software Engineering and Methodology
Acta Informatica
AI Magazine
Algorithmica
Annals of Mathematics and AI
Applied Mathematics and Computation
Artificial Intelligence
BIT
BYTE
Combinatorics, Probability and Computing
Communications of the ACM
Computational Complexity
Computational Intelligence
Computer
Computer Aided Geometric Design
Computer Architecture News
Computer Communication
Computer Design
Computer Journal
Computer Languages
Computers and Mathematics with Applications
Computers and Security
Computing
Cybernetics
Database Programming
Distributed Computing
Expert Systems
Formal Aspects of Computing
Fundamenta Informaticae
Future Generation Computer Systems
Fuzzy Sets and Systems
IEEE Concurrency
IEEE Internet Computing
IEEE Micro - Chips, Systems, Software and Applications
IEEE Multimedia
IEEE Software
IEEE Transactions on Multimedia
IEEE Transactions of Information Theory
IEEE Transactions on Evolutionary Computation
IEEE Transactions on Fuzzy Systems
IEEE Transactions on Knowledge and Data Engineering
IEEE Transactions on Neural Networks
IEEE Transactions on Parallel and Distributed Systems

IEEE Transactions on Pattern Analysis and Machine Intelligence
IEEE Transactions on Software Engineering
IEEE Transactions on Systems, Man and Cybernetics ; Part A and B
Information and Computation
Information Processing Letters
Information Systems Research
Interacting With Computers
International Journal of Computational Geometry and Applications
International Journal of Foundations of Computer Science
International Journal of Human Computer Interaction
International Journal of Parallel Programming
International Journal of Systems Science
Journal of Algorithms
Journal of Automated Reasoning
Journal of Computation and Applied Mathematics
Journal of Computational Analysis
Journal of Computer and System Sciences
Journal of Computer Information Systems
Journal of Cryptology
Journal of Database Management
Journal of End-User Computing
Journal of Functional Programming
Journal of Logic and Computation
Journal of Logic Programming
Journal of Network and Computer Applications
Journal of Object Oriented Programming
Journal of Parallel and Distributed Computing
Journal of Scientific Computing
Journal of System Architecture
Journal of Systems and Software
Journal of Systems Architecture
Journal of the ACM
Journal of Visual Languages and Computing
Knowledge and Information Systems
Knowledge Based Systems
Linux Journal
Mathematical and Computer Modeling
Mathematical Programming
Mathematical Structures in Computer Science
Mathematics and Computer Education
Mathematics and Computers in Simulation
Mathematics of Computation
Microcomputer Applications
Multimedia Systems
Network: Computation in Neural Systems
Neural Computing and Applications
Neural Networks
Parallel Computing
Parallel Processing Letters
Pattern Recognition
Problems of Information Transmission
Programming and Computer Software
Random Structures and Algorithms
SIAM Journal on Computing
SIAM Journal on Scientific Computing
SIGMOD Record
Soft Computing
Software Concepts and Tools
Software Engineering Notes
Software Practice and Experience
Software Testing, Verification and Reliability
Systems and Control Letters
Theoretical Computer Science
Unix Review
Virtual Reality
Visual Computer
VLDB International Journal on Very Large Databases

# 5 Graduate Faculty

## Dr. Huseyin Kocak, Professor and Chairman

Ph.D. in Mathematics, 1980, University of California at Santa Cruz.
**Research Interests:** Dynamical Systems and their applications to biology, ecology and medicine; Scientific Computing, Visualization.
**Students:** Huseyin has advised and/or served on the committees of several dozen Master's and Doctoral students from The College of Arts and Sciences, School of Engineering, School of Atmospheric and Marine Sciences, and the former School of International Studies. He graduated an interdepartmental Ph.D. student, McKnight Fellow Morgan Johnson (2006). Currently, he is advising the Master's Thesis of Craig Kolthoff of the IT department.

## Dr. Thomas LeBlanc, Professor Executive Vice President and Provost

Thomas J. LeBlanc, executive vice president and provost, was appointed in 2005. He is the chief academic officer and chief budget officer for the University and is responsible for overseeing and coordinating academic programs and enhancing the educational mission of the University. He is also a professor in the Departments of Computer Science and Electrical and Computer Engineering. Previously, LeBlanc served as dean of the college faculty in the College of

Arts, Sciences, and Engineering at the University of Rochester. His publications include writings on operating systems, parallel programming, and software engineering. He holds a Ph.D. and a master's degree in Computer Science from the University of Wisconsin at Madison and a Bachelor of Science in Computer Science from State University of New York at Plattsburgh [http://www6.miami.edu/UMH/CDA/UMH_Main/0,1770,2472-1;46573-3,00.html].

### Dr. Victor Milenkovic, Professor

Ph.D., 1988, Carnegie Mellon University.
**Research Interests:** Computational Geometry, Layout, Graphics, Numerical Issues, Computational Chemistry.
**Students:** Victor has graduated two Computer Science Ph.D. students at Harvard University, one of whom, Karen Daniels, is now a tenured associate professor, and one interdepartmental Ph.D. students at UM: Harald Schmidl. He has advised and served on the committees of numerous master's degree students. He is currently advising and funding interdepartmental PhD. student Steven Trac on an NSF grant and hopes to transition Steven to the new Ph.D. program.

### Dr. Shahriar Negahdaripour, Secondary Appointment, Professor of Electrical and Computer Engineering

Ph.D. Electrical Engineering, 1987, MIT.
**Research Interests:** Underwater Vision and Imaging.
**Active Projects:** 1) Integrated high-precision opti-acoustic imaging and positioning platform for underwater search and inspection, ONR DURIP, June'06- June'07. 2) Investigation of Multiple-View 3-D Reconstruction Methods with FS Sonar Video Cameras ONR, June'05- April'08.

### Dr. Mitsunori Ogihara, Professor

Ph.D. Information Technology, 1993, Tokyo Institute of Technology.
**Research Interests:** Computational Complexity, Molecular Computation, Data-Mining, Bioinformatics.
**Students:** Alina Beygelzimer (PhD: 2003), Yin-He Cheng (PhD: 2004), Gabriel Istrate (PhD: 1999), Ashwin Lall (expected defense: May, 2008), Tao Li (PhD: 2004), Srinivasan Parthasarathy (PhD: 1999), Bin Wei (expected defense: May, 2010). Mohammed Javeed Zaki (PhD: 1998), Chengliang Zhang (expected defense: July, 2007).

### Dimitris Papamichail, Assistant Professor

Ph.D., 2007, SUNY at Stony Brook.
**Research Interests:** Bioinformatics, algorithms and data structures, optimization, decision sup-

port systems.

### Dr. Victor Pestien, Secondary Appointment, Associate Professor of Mathematics

Ph.D. Mathematics, 1980, University of California at Berkeley.
**Research Interests:** Probability, Optimization.
**Students** (Ph.D., Mathematics): Michael G. Monticino, "The adequacy of measurable and of stationary strategies for approximating optimal return", Mathematics and Computer Science, University of Miami, May, 1987. Xiaobo Wang, "Reward functions and Markov strategies in finite-stage stochastic decision problems", Mathematics and Computer Science, University of Miami, July, 1992. Kevin R. Ruth, "Favorable red and black on the integers with a minimum wager9', Mathematics and Computer Science, University of Miami, December, 1999.

### Dr. Subramanian Ramakrishnan, Secondary Appointment, Associate Professor of Mathematics

Ph.D. Mathematics, 1980, Indian Statistical Institute
**Research Interests:** Probability, Statistics.
**Students** (Mathematics): Carlos Canas, DA project, Queueing Networks in Discrete-time: Exact results and Approximations, 2004. 2) John Beam, Ph.D. thesis, Expectations for Coherent probabilities, 2002.

### Dr. Burton Rosenberg, Associate Professor and Director of Technology

Ph.D., 1991, Princeton University.
**Research Interests:** Cryptography and security; scientific visualization and computation; mathematical finance.
**Students:** Launched webmail project with undergraduate Matt Mankins. Eventually sold as emumail, www.emumail.com. Advised one master's student, served on the committee for six other master students.

### Dr. Dilip Sarkar, Associate Professor and Director of Graduate Studies

Ph.D., 1988, University of Central Florida.
**Research Interests:** High-speed Networks, Mobile and Wireless Computing, Multimedia Communication and Systems, QoS on the Web
**Students:** Dilip is supervising two interdisciplinary Ph.D. students at UM: Wing Tong and Wei

Zhou. He is also advising three master's students. In the past, Dilip has advised 25 master's degree students and served on the committees for several master's and Ph.D. degree students.

### Dr. Geoff Sutcliffe, Associate Professor and Director of Undergraduate Studies

Ph.D., 1992, The University of Western Australia.
**Research Interests:** Automated Theorem Proving (ATP), Evaluation of ATP Systems, Distributed and Parallel ATP
**Students:**
2005-2006 MS Supervisor, Shen W., Automated Proofs of Relationships Between Modal Logic Systems, University of Miami.
2004-2006 MS Supervisor, Moynihan K., Lascaux - An Intelligent Artistic Agent, University of Miami.
2003-2005 MS Supervisor, Zhang Y., The Use of Lemmas for Solving Hard Automated Theorem Proving Problems, University of Miami.
2003-2004 MS Supervisor, Gao Y., Automated Generation of Interesting Theorems, University of Miami.
1998-2003 MSc Supervisor, Brown M., Semantic Guidance for Linear ATP Systems, James Cook University.
1994 MSc Supervisor, Nugroho L., A Programmer's Tool for Managing Persistent Object Structures, James Cook University.
1990 MAppSc Supervisor, Tabada W., An Analysis and Implementation of Linear Derivation Strategies, Edith Cowan University.

## 6 Bulletin Description

This is the proposed bulletin description for the Ph.D. program.

### Doctor of Philosophy in Computer Science

The following requirements are in addition to the general requirements for the Doctor of Philosophy Degree as described by the Graduate School. The Computer Science Graduate Committee (CSGC) maintains full authority over all decisions pertaining to a Ph.D. student.

1. **Admission Requirements:** In order to be admitted to the Ph.D. program in Computer Science, an applicant must have obtained a minimum of 15 credits in courses at sophomore level and above. These courses in the computer science department at UM are numbered 200 and above. Applicants may be admitted with deficiencies; these must be completed in addition to the degree requirements.

2. **Written Qualifying Exam:** The student must pass a three-hour written exam of general knowledge of Computer Science at the end of the first year. Upon failure, the student may petition the CSGC to allow a second attempt at the end of the second year.

   The exam will be administered once a year in the early weeks of the summer session. It will cover expected knowledge of all first-year graduate students. Included in this material are a fundamental understanding of algorithm analysis and design, advanced skills in programming, basic knowledge of computer architecture, and a general understanding of computer systems.

3. **Classroom Course Requirements:** In the first two years, the student must take eight CSGC-approved classroom courses, for a total of 24 credits. At least four of these courses (12 credits) must be open only to graduate students. These courses at UM are numbered 600 and above.

   The eight courses must include two courses from each of the areas of Analysis, Applications, and Systems. The student should work with his or her advisor to select a cohesive set of courses as approved by the CSGC.

   The CSGC will have sole authority in designating the areas to which each course belongs. In the case that a course is designated in more than one area, a student may apply the course to only one area. The designation of current CSGC-approved courses appears at the end of this description.

4. **Project Course Requirements:** By the end of the second year the student must complete two graduate level project courses for a minimum total of 6 credits. Each project shall be under the supervision of a *different* faculty member in the Department.

   All Ph.D. students must find faculty willing to supervise their project in the semester preceding the project. The deadline for finding a supervisor shall be the first full week in April or November for the Fall and Spring terms, respectively. This deadline does not require identifying a specific project but only finding a faculty member willing to supervise a project.

   Upon completion of a project, the student must write a detailed project report. This report shall become a public document and shall be kept on file by the Department. The student must present the finished project to a quorum of the CSGC at a time to be approved by the chairman of the Department. The supervisor and CSGC must approve each project as applicable toward candidacy for a Ph.D. A primary factor in determining approval shall be the stated willingness of the supervisor to become an initial Ph.D. advisor for the student.

5. **Annual Presentations:** After passing the written qualifying exam, the student must make a public oral presentation to the Department at least once per year. These presentations include the two project presentations, the thesis proposal, and the thesis defense. The goals are to develop the student's oral and presentation skills, to provide a means for the Department to check the research and progress of the student, and to present the opportunity for feedback to improve the student's research.

6. **Teaching Experience:** Each student must teach a lab-based course for a minimum of one semester. Lab-based courses typically require the student to present material in a relaxed lecture format, re-emphasizing material learned in the general lecture as well as introducing new material to the students.

## Approved Course Categories

The following is a list of approved courses for each of the three categories:

### Analysis

| | |
|---|---|
| CSC 506 | Logic |
| CSC 517 | Data Structures and Algorithm Analysis |
| CSC 518 | Compiler Theory |
| CSC 519 | Programming Languages |
| CSC 527 | Theory of Computing |
| CSC 531 | Introduction to Software Engineering |
| CSC 540 | Algorithm Design and Analysis |
| CSC 545 | Introduction to Artificial Intelligence |
| CSC 606 | Logic Programming |
| CSC 609 | Cryptography and Data Security |
| CSC 611 | Theory of Computation |
| CSC 612 | Theory of Complexity |
| CSC 623 | Theory of Relational Databases |
| CSC 628 | Parallel Algorithms |
| CSC 646 | Neural Computing |
| CSC 647 | Computational Geometry |
| EEN 634 | Modeling and Analysis of Computer Networks |
| EEN 656 | Information Theory |
| MTH 509 | Discrete Mathematics II |
| MTH 520 | Numerical Analysis I |
| MTH 521 | Numerical Analysis II |
| MTH 528 | Combinatorics |

### Applications

| | |
|---|---|
| CSC 523 | Principles of Filing and Database Systems |
| CSC 529 | Introduction to Computer Graphics |
| CSC 545 | Introduction to Artificial Intelligence |
| CSC 555 | Multimedia Systems |
| CSC 628 | Parallel Algorithms |
| CSC 645 | Expert System Design |
| CSC 646 | Neural Computing |
| CSC 648 | Automated Reasoning |
| CSC 655 | Advanced Multimedia Systems |
| EEN 577 | Data Mining |
| EEN 638 | Computer Vision |
| EEN 653 | Pattern Recognition and Neural Networks |
| MTH 520 | Numerical Analysis I |
| MTH 521 | Numerical Analysis II |

### Systems

| | |
|---|---|
| CSC 518 | Compiler Theory |
| CSC 519 | Programming Languages |
| CSC 521 | Principles of Computer Operating Systems |
| CSC 523 | Principles of Filing and Database Systems |
| CSC 524 | Networks and Information Security |
| CSC 555 | Multimedia Systems |
| CSC 609 | Cryptography and Data Security |
| CSC 645 | Expert System Design |
| CSC 655 | Advanced Multimedia Systems |
| EEN 514 | Computer Architecture |
| EEN 534 | Computer Communication Networks |
| EEN 614 | Advanced Computer Architecture |
| EEN 634 | Modeling and Analysis of Computer Networks |
| EEN 671 | Advanced Interactive Multimedia Information Systems |

# 7 Questions and Answers

**Q**: Are the courses in place to offer a Ph.D. and are they being taught?
**A**: Yes and yes. Our master's program is unashamedly research-oriented and we graduate many master's students each year, many of whom write master's theses that are published in journals. No new courses are planned for the Ph.D. program, nor do we plan to change the frequency. Section 8 provides data on the number of master's degrees bestowed in the past five years. Section 8 also provides data on past and planned future course offerings at the undergraduate and graduate level.

**Q**: How will we support the new Ph.D. students?
**A**: The department is able to award seven teaching assistantships to highly qualified students. Currently, we can only offer these to master's students. Obviously, we will also seek funding from outside the university for research assistantships. There is a shortage of Ph.D.s in Computer Science, and there is much external funding available for graduate work.

**Q**: What about the $100,000/year/faculty external funding?
**A**: A mature, successful Ph.D. program is *necessary* to reach this national average, but it is not necessarily *sufficient*. It is mere speculation that we will ever reach this level of external funding. *Instead,* this proposal is based solidly on past performance and current resources.

**Q**: Won't the number of master's students decrease as a result of shifting the resources?
**A**: Possibly but gradually: we plan to be very selective in the admission of Ph.D. students, leaving the remaining teaching assistantships for highly qualified master's students as before.

**Q**: Shouldn't we hire a few more faculty before establishing a Ph.D. program?
**A**: By requiring that student do research projects with two different faculty for candidacy, the new program is specifically designed to avoid "orphaning". Furthermore, with an established record of assigning teaching assistantships to master's students, we can afford to offer assistantships only to those Ph.D. applicants whose interests closely fit those of the faculty. Since a significant portion of potential *faculty* applicants will eschew a university without a Ph.D. program, perhaps the question should be, "Shouldn't we establish a Ph.D. program before hiring more faculty?"

**Q**: Won't the new Ph.D. program steal faculty time away from the undergraduates?
**A**: Again, quite the opposite: the *lack* of a Ph.D. program steals time from the undergraduate program. Given the universality of Ph.D. programs at research institutions, our faculty are expected to have a certain level of productivity in order to obtain grants and promotions. With a master's student, a faculty member has to spend much time and effort getting the student up to speed only to generate perhaps one joint paper. A Ph.D. student requires hardly more effort and leads to a much longer and more fruitful collaboration. So basically, the lack of a Ph.D. program means that faculty have to take time away from undergraduates in order to train graduate students.

**Q**: How does this program relate to those provided by the universities listed in Section 8?
**A**: For the most part, the program follows that of Johns Hopkins, also a young department. It

Table 1: Comparison of proposed program with several AAU universities. JHU=The Johns Hopkins University; UNC=The University of North Carolina at Chapel Hill; UFL=University of Florida, Gainesville.

| | UM | JHU | Duke | UNC | UFL |
|---|---|---|---|---|---|
| concentration courses | 2 | 2 | 4 | 3 | 4 |
| breadth courses | 6 | 6 | 4 | 6 | 6 |
| project courses | 2 | 2 | 0 | 0 | 0 |
| annual presentations | yes | yes | no | no | no |
| attend colloquia | no | yes | no | yes | yes |
| teaching | yes | yes | no | no | yes |
| written qualifier | yes | no | yes | yes | yes |
| oral qualifier | no | yes | no | yes | no |

requires courses in three areas–Analysis, Applications, and Systems–and it requires projects with two different faculty members. Table 7 compares the proposed program to Ph.D. programs at JHU and other nearby AAU universities. We note that many departments require attendance at colloquia. The Computer Science Department currently requires graduate students to attend as a condition of receiving a teaching assistantship.

# 8 Additional Supporting Materials

1. Approval of College of Arts and Sciences, November 16, 2004.
2. Total number of MS degrees awarded in the last five years.
3. Undergraduate and graduate teaching of computer science courses: 1994-2000.
4. Undergraduate and graduate teaching of computer science courses: 2000-2007 (anticipated).
5. CV: Huseyin Kocak
6. CV: Thomas LeBlanc
7. CV: Victor J. Milenkovic.
8. CV: Shahriar Negahdaripour
9. CV: Mitsunori Ogihara
10. CV: Dimitris Papamichail
11. CV: Victor Pestien

12. CV: Subramanian Ramakrishnan
13. CV: Burton Rosenberg.
14. CV: Dilip Sarkar.
15. CV: Geoff Sutcliffe.
16. 2005-2006 CRA Taulbee Survey.
17. 2004-2005 CRA Taulbee Survey.
18. 2001-2002 Industry Salary Survey
19. CRA Forsythe List of Ph.D.-granting departments.
20. List of Florida Ph.D.-granting departments.
21. Johns Hopkins University (CS Dept), Program for Ph.D. students.
22. Duke University (CS Dept), Program for Ph.D. students.
23. University of North Carolina (CS Dept), Program for Ph.D. students.
24. University of Florida (CS Dept), Program for Ph.D. students.
25. Graduate Education in Computational Science and Engineering. *SIAM Review*, Volume 43, Number 1, pp. 163-177.
26. Proposal to the Faculty Senate to establish a new Department of Computer Science, approved January 1999.

UNIVERSITY OF Miami

**MEMORANDUM**

March 10, 2008

TO: Faculty Senate

FROM: Hüseyin Koçak
Chair, Department of Computer Science

SUBJECT: Ph.D. Program in Computer Science

This memo serves to confirm that the Department of Computer Sciences faculty unanimously approved the Ph.D. Program in Computer Science. The proposal is now forwarded to the Faculty Senate for action. No additional funds are being requested for the successful implementation of the proposed Ph.D. program in Computer Science.

Department of Computer Science
College of Arts & Sciences
P.O. Box 248154
Coral Gables, Florida 33124-4245
305-284-2268
Fax: 305-284-2264

MEMORANDUM

To: Chair, Faculty Senate,

FROM: Dean Terri Scandura, Graduate School Terri A. Scandura

DATE: 29 February 2008

SUBJ: New Graduate Program in Computer Science

At the 27 October 2007 meeting of the Graduate Council the proposed Ph.D. program in Computer Science was approved unanimously by those present.

CC: SACS Office
Graduate School Program Review File

**MEMORANDUM**

TO: Steve Ullmann
Vice Provost and Dean of Graduate Schools

FROM: Angel Kaifer
Vice Dean for Life and Physical Sciences

SUBJECT: Ph.D. Program in Computer Science

At its meeting on 16 November 2004, the College of Arts and Sciences faculty unanimously approved the Ph.D. Program in Computer Science. The proposal is now forwarded to the Graduate Council for action.

cc: Huseyin Kocak, Interim chair
Department of Computer Science

Attachment: Ph.D. in Computer Science Proposal

UNIVERSITY OF
Miami
COLLEGE OF ENGINEERING

**MEMORANDUM**

To: H. Kocak, Chairman, CS Department

CC: J. M. Tien, Dean CoE; S. Sapp, Chairman, Faculty Senate

From: J. W. Modestino, Chairman, ECE Department

Date: March 25, 2008

Re: Support of CS Ph.D. Program Proposal

As you have requested, the ECE Department would like to formally endorse and support the proposal by the CS Department to create a Ph.D. program in Computer Science. We have examined the proposal and it appears academically sound and certainly appropriate given the expanding research interests and capabilities in the CS Department. It is our hope that this development could enhance the potential for stronger research collaborations between CS and ECE faculty, and their respective students.

Our only concern at this point is that there be in place a mechanism for coordinating the development of new graduate course offering between the two Departments to avoid the potential for wasteful duplication of effort. Specifically, this could be accomplished by having the respective graduate program coordinators in each Department coordinate the introduction and scheduling of graduate courses so that students in both Departments can take advantage of such offerings while avoiding wasteful use of faculty resources.

Subject to this single concern, the ECE Department strongly supports this proposal.

Department of Electrical and Computer Engineering • P.O. Box 248294 • Coral Gables, Florida 33124-0640
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UNIVERSITY OF Miami

March 26, 2008

STATEMENT OF SUPPORT
PHD PROPOSAL IN COMPUTER SCIENCE
Prof. Zame
Chair, Mathematics Department

With very few exceptions major research universities have excellent Computer Science Departments with PhD programs. Computer science was part of mathematics for many years and the goal was always to start a PhD program once there were sufficient faculty, which was generally considered to be six to eight, with most tenured. We never reached that level. Computer science was separated from Mathematics at the end of the '90's and it has now finally become substantial enough to support a PhD program. There are currently four full professors, three tenured associate professors and one junior faculty member in the department. There is also considerable interest and support available for computer science elsewhere in the College of Arts and Sciences and the University as a whole. There is now a supercomputer center. There are very good faculty in the Department, but these faculty need the kind of students they would get in a PhD program to continue their work and obtain more funding. Up until now, faculty had to have PhD students in some interdisciplinary programs, making it more difficult for all involved. The proposed new degree does not initially call for new faculty or resources. My assumption would be that if the program progresses as hoped then new resources will be developed over time.

In short, it is necessary for the University of Miami, if it is ever going to achieve its aspiration of AAU membership, to have a viable PhD program in computer science, and the department has progressed to the point that the program is now feasible. This program is long overdue.

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# General Welfare Committee
# March 19, 2008
# 3:30 p.m.
# (School of Law Library-Conference Room, 4th floor)

1. Chair's remarks (3:30)

2. # Review of draft Faculty Senate Meeting Minutes of February 27, 2008 (3:35)

3. # Miami Institute for Human Genomics and Component Center Proposals – J. McCafferty-Cepero (3:40)

4. # Proposal for a Doctor of Philosophy in Computer Science – H. Kocak (3:55)

5. ## Academic Standards Committee Undergraduate Admission Report – (4:10)

6. ## Proposal Regarding Latin Honors – (4:25)

7. Outstanding Teaching Award Committee Recommendation – E. Clasby (4:40)

8. # Request for Guidance Concerning Doctoral Study in Their Home Department/School by Masters-Prepared Faculty in Physical Therapy and Nursing – S. Hayes, V. Mitrani (4:50)

9. # Proposal for a New Degree Program, the Master in Real Estate Development and Urbanism (MRED&U) – C. Bohl, D. Hector (5:20)

10. # Move of Masters of Public Administration from the School of Business Administration to the College of Arts and Sciences – Note: a memo from the Dean of Arts and Sciences will be forthcoming - (5:35)

11. # Senate Apportionment - (5:40)

# related material included
## materials will be sent separately

**March 26, 2008**
**Faculty Senate minutes**

The meeting, held in the BankUnited Center Hurricane 100 Room, opened at 3:35 p.m.

**CHAIR'S REMARKS**
The First Vice Chair announced that she will be chairing today's meeting and highlighted some of the information in the Chair's remarks that were part of the agenda package.

**PRESIDENT'S REMARKS**
The President explained that she and the Provost were in the middle of the SACS on-site review visit. She reported on the new hospital and said that we are on-budget and are about to complete the permanent financing, which will be less than what was projected due to the market. She had warned the trustees that the rating agencies might downgrade us because of the debt load we would be incurring, but instead they noted our strong balance sheets and did not downgrade us.

We are struggling in Tallahassee because the Senate has cut FRAG money for each Florida student attending private colleges and universities. Our full-time lobbying staff is still fighting this legislation. We also expect some other programming cuts.

The Board of Trustees Finance Committee approved the Financial Plan that accompanies the Strategic Plan and recommended construction of the new Business School building in anticipation of its approval by the Master Planning and Construction Committee.

The Provost shared that the SACS on-site team is concluding its work on campus and is meeting in executive session now to formulate its findings and recommendations. He feels that the visit is going well and thanked everyone who participated.

He stated that the Miller School of Medicine portion of the Strategic Plan went to the Board's Medical Affairs Committee this morning for their approval and will then be forwarded to the Executive Committee. As the President mentioned, the Financial Plan as presented earlier to the Senate's Budget and Compensation Committee was approved by the Board Finance Committee, and the Administration is hopeful that it will be approved in May by the Board.

The Provost reported on the University's investments. For the last fiscal year, 2007, our return on the growth pool was 19.7% for the year. The benchmark we were attempting to beat was 17.7%. So far for fiscal year 2008 we are down 4.9%. Our benchmark is 4.3%. UM uses a three-year moving average that smoothes out discontinuities in the market. The President and Provost entertained questions from the floor.

**APPROVAL OF TODAY'S AGENDA**
The meeting agenda *passed unanimously.*

**APPROVAL OF MINUTES OF FEBRUARY 27, 2008**
The minutes of February 27, 2008, *passed unanimously.*

**INTRODUCTION OF SHERI A. KEITZ, M.D. PH.D.**
Dr. Keitz is the Associate Dean for Faculty Diversity and Development, Miller School of Medicine. She has been a physician for about 18 years and her goal is to do what she can to optimize the care of the patient and populations that we work with and to make an impact on the future. She thanked the Senate for its work in extending the tenure clock at the Miller School of Medicine.

**MIAMI INSTITUTE FOR HUMAN GENOMICS [MIHG] AND COMPONENT CENTER PROPOSALS**
[Please contact the Senate office to view the proposal.]
Jennifer McCafferty-Cepero presented the proposal with the suggestions requested and approved by the General Welfare Committee. She reviewed the proposal that creates an umbrella institution called the "Miami Institute for Human Genomics" with five separate component centers. The intent is for the centers to exist within the umbrella institute and not to exist in the absence of that institute as was recommended by the General Welfare Committee. The institute will reside initially at the Miller School of Medicine and will house disciplines that draw from a variety of departments at the Miller School. The letters of support for the institute come from all of the basic science chairs, a majority of the clinical departments that have research activities, and the major centers and institutes that already exist at Miller. The five-year projected plan was inadvertently missing from the proposal included with the materials so Dr. McCafferty-Cepero gave an oral summary. She then entertained questions from the floor.

A senator stated that he expects to see regular review of centers and institutes, and another senator asked about provisions to address the ethical aspects raised by advances in human genetics. Dr. McCafferty-Cepero responded that the institute is developing a program in conjunction with Dr. Ken Goodman of the University Ethics Programs.

*A motion was made and seconded* to approve the proposal. The motion was *approved unanimously.*

**PROPOSAL FOR A DOCTOR OF PHILOSOPHY IN COMPUTER SCIENCE**
[Please contact the Senate office to view the proposal.]
Huseyin Kocak presented the proposal for a Doctor of Philosophy in Computer Science. He pointed out that he had received additional letters of support as was requested by the Senate Chair. There is no additional funding needed. There were no questions.

*A motion was made and seconded* to approve the proposal. The motion was *approved unanimously.*

**PROPOSAL FOR A NEW DEGREE PROGRAM, THE MASTER IN REAL ESTATE DEVELOPMENT AND URBANISM (MRED&U)**
[Please contact the Senate office to view the proposal.]

Dean Elizabeth Plater-Zyberk was accompanied by Charles Bohl and presented the proposal. She discussed the aspects of design and the larger context of sustainable and livable communities, with concerns for environmental conservation, social equity, and economics. The University of Miami School of Architecture is recognized as the top school in the country for presenting the principles of the new urbanism. The Knight Program in Community Building has brought significant experience in the implementation of the principles, which have been built in and espoused by the faculty. This new degree is intended to be a mid-career program that will work with fellows of multiple disciplines and communities around the country under the sponsorship of the Knight Program. The comments of the General Welfare Committee regarding incorporation of ecological responsibility into the degree were endorsed by the school's faculty and wording was added to the proposal to reflect this commitment. The presenters entertained questions and comments from the floor.

*A motion was made and seconded* to approve the proposal. The motion was *approved unanimously.*

**ACADEMIC STANDARDS COMMITTEE UNDERGRADUATE ADMISSION REPORT**
[Please contact the Senate office to view the proposal.]
Dr. R. Stephen Cantrell, *ex officio* member of the committee, noted that the report is a continuation of reports in the past. He highlighted the comparisons of the university with other universities in the report and entertained questions from the floor. The Provost also reiterated some of the points of his presentation at the last Senate meeting. The Provost also entertained comments/questions from the floor.

*A motion was made and seconded* to accept the report. The motion was *approved unanimously.*

*A motion was made and seconded* to adopt the recommendation of the committee as the Senate's recommendation. The motion was *approved unanimously.*

**MOVE OF MASTER OF PUBLIC ADMINISTRATON FROM THE SCHOOL OF BUSINESS TO THE COLLEGE OF ARTS AND SCIENCES**
The First Vice Chair presented the proposal to move the Master of Public Administration from the School of Business to the College of Arts and Sciences.

*A motion was made and seconded* to approve the proposal. The motion was *approved unanimously.*

**SENATE APPORTIONMENT**
The First Vice Chair presented the General Welfare Committee's recommendation that the apportionment constant be kept at 10, increasing the number of senators to 50 by adding one senator for the Miller School of Medicine and one for the Frost School of Music.

*A motion was made and seconded* to approve the proposal. The motion was *approved unanimously.*

**NOMINATING COMMITTEE**

The Vice Chair pointed out that the Chair is willing to serve as chair again next year and thus has suggested that the Senate elect the Nominating Committee for next year's Senate officers. Norman Einspruch, Marvin Dawkins, Lenny Koniaris, Patricia Byers, and Lynne Fieber were nominated from the floor.

*A motion was made and seconded* to elect these individuals as the Nominating Committee. The motion was *approved unanimously.*

The remainder of the meeting was held in Executive Session to discuss the Outstanding Teaching Award recommendation.

The meeting adjourned at 6:09 p.m.

Respectfully Submitted,
Robyn Hardeman
Secretary of the Faculty Senate

# A Proposal for a New Degree Program
# Doctor of Philosophy in Computer Science

Unanimously Approved by College of Arts and Science, November 16, 2004

Revised: November 29, 2007 *

Department of Computer Science
College of Arts and Sciences
University of Miami

GWC
version

*Introduction and personnel updated. No changes have been made to requirements of program.

# Contents

# 1 Introduction

## 1.1 The Field of Computer Science

Computer science is the systematic study of computation. The fundamental building blocks of the field are algorithms, the descriptions of computational processes in terms of well-defined instructions. Algorithms capture underlying ideas behind computation and enable conversations among scientists without having to use specific programming languages. While the concept of algorithms has existed for more than two millenia, it is only in the later part of the last century that the first academic computer science departments were created. Despite its infancy, however, the field of computer science has grown at a remarkable speed and has now acquired a prominent position in academic institutions, both in the states and in other modern countries. The growth is in part due to the rapid advancements in computer technologies, as observed in the so-called Moore's law, which states that the density of transistors on computer chips doubles every eighteen months. However, what truly propelled the growth are the ingenious concepts and earth-shaking algorithms produced by computer scientists, which have made computing more interesting, more effective, and more accessible. Such ideas include computer graphics, email, object-oriented programming, public-key cryptography, sorting, string matching, virtual reality, and world-wide web. The influence of those revolutionary ideas have gone very far beyond the boundary of computer science. Computing has become not only a central tool for many fields of natural sciences, engineering, social sciences, business, medicine and arts but an essential part of human life. This unprecedented ubiquity puts computer science in a very unique position in academe and makes it one of the most important, if not the most important, disciplines of the 21st century.

Critical missions of any scholastic discipline are research and education, and in many disciplines the two missions are intricately related with each other. This is certainly the case for computer science. In most research areas of computer science, investigations are through experimentation involving complex computer programs. Academic computer scientists can therefore speed up substantially their research investigations by teaming up with graduate students that understand and implement underlying scientific ideas. This partnership between the advisers and the advisees are mutually beneficial. While the gain of speed allows the researchers to produce more results, the graduate students receive critical training through hands-on research experience. Since even the most advanced computing technologies of today may be become outdated tomorrow, graduate computer science training must instill in students universal research skills that stand the test of time.

## 1.2 The UM Computer Science Department

At the University of Miami, the Computer Science Department was created in 2000 out of the Mathematics Department, in part for the purpose of serving the growing demands of the UM undergraduate students to receive education in the field. The research expertise of the current

Computer Science tenure-track faculty touches upon a variety of key research areas: artificial intelligence, automated reasoning, bioinformatics, computational complexity, computational geometry, computer graphics, cryptography and security, data mining, large-scale modeling, molecular computation, multimedia systems, and network algorithms. The initially-approved target size of the graduate faculty is eight, and the department has currently seven tenure-track faculty members (five of them are tenured). The existing tenure-track faculty members received graduate training in the areas that have a strong focus on algorithms, i.e., the abstract ideas underlying computation. This makes them ideal for teaching students how to think creatively using standard methodologies as well as how to transfer ideas from one subject to another. The proximity of the Department to researchers in the University whose work heavily uses computation (those in the Departments of Biology, Chemistry, and Physics on the Coral Gables Campus and those in the Schools of Marine and Atmospheric Sciences and of Medicine) offers tremendous advantage for these researchers to engage in interdisciplinary collaboration with members of the Department. In fact, the Computer Science Department has a proven record of exploring such opportunities to produce excellent research outcomes, and of training students through such projects. The Department takes its pride in having sent both of its undergraduate and graduate students to top jobs, both in the mainstream computer science field and in interdisciplinary fields, such as bioinformatics.

The interdisciplinary research of the Department is expected to be strengthened further through its involvement with the recently created Center for Computational Sciences. The Center is expected to offer five core research programs, each led by a director having a tenure-track primary appointment. So far only one core program director has been recruited, and that director is primarily appointed in Computer Science. The rest of the program directors will be recruited in the next two years, and one or two of them are likely also to have appointments in Computer Science. Also, it is anticipated that many of the in-house Ph.D. researchers of the Center, who directly report to program directors, will have formal affiliations with the Department. The affiliation of the directors and the researchers gives a tremendous opportunity for the Department to extend its research horizon and widen its educational programs. The Department believes that by capitalizing this unique opportunity it will be able to boost its external research funding substantially, produce more high quality research, and enrich its educational programs, and thereby increase its visibility both within the University and in the national and international computing research communities.

## 1.3 The Purpose of This Document

Establishing a Ph.D. program will greatly speed up the research progress and make the Department significantly more productive and more visible. The Department hereby requests approval to establish such a program, with the goal of enrolling the first batch of students in the academic year of 2008-09.

The requested Ph.D. leverages the existing mature Master of Science program in Computer Science, which the Department inherited from the Mathematics program and which has been graduating

students since 1971. Since 1996, the Master of Science program has graduated 54 students[1]. The classroom courses taught for the Master of Science program (and in the Computer Engineering program) are sufficient for starting a Doctor of Philosophy program in Computer Science of minimum breadth. (See the table of Computer Science courses taught from 1994 to 2007 in Section 7.)

### 1.4 Outline of the Rest of the Document

Section 2 discusses the expected outcomes of the requested Ph.D. program. Section 3 provides the description of the new program, which closely follows the Ph.D. curriculum in computer science at several prominent universities. Section 3.5 presents the current categorized list of approved graduate-level courses. Section 4 describes the resources available to the students of the new program. Section 5 gives a short description of each graduate faculty member in the Department of Computer Science. Section 6 provides the text that should be added to the graduate bulletin. Section 7 answers some common questions about the proposal. Section 8 gives additional supporting material. Curriculum Vitae are attached.

## 2 Expected Outcomes

### 2.1 Interdisciplinary Ph.D. Programs

The March 2001 issue of the SIAM Review contains an article describing an influential program that mixes a graduate Computer Science curriculum with other science and engineering-oriented curricula. The article states, "Computational science and engineering (CSE) is a rapidly growing multidisciplinary area with connections to the sciences, engineering, mathematics, and computer science." The influence of Computer Science is strong in such fields as biology, chemistry, physics, medicine, and bioengineering. Many universities across the country have already established such interdisciplinary programs, in particular, establishing interdisciplinary programs in computational biology/bioinformatics has been a trend in the past few years. For example, the CSE Program at Purdue University "offers [MS and Ph.D.] specializations in computational science and computational engineering in 17 departments..." Although such an interdisciplinary program is certainly worth pursuing, before the University can create such a program it must have as a basis to cover the fundamentals, including a strong Ph.D. program in Computer Science.

### 2.2 Undergraduate and Graduate Relationships

Graduate teaching assistants, who currently are master's students, run course labs (for courses with a lab in addition to a lecture), grade homework, and monitor the teaching lab during non-class daytime hours, nights, and weekends, when the undergraduates work on their programming

[1] See Section 8

assignments. Since Ph.D. students will remain in the Department longer than master's students, they will have more time to gain research and teaching experience. This teaching experience will directly benefit the undergraduate Computer Science program and the undergraduate students in the University. For example, a Ph.D. student will have the opportunity to assist a greater variety of courses and thus is more likely to be able to answer a question posed by an undergraduate when the Ph.D. student is monitoring the teaching lab.

In addition to enhancing the current duties of teaching assistants, Ph.D. students will serve two new roles. First, Ph.D. students will help bridge faculty research to undergraduates. Second, Ph.D. students act as role models for undergraduates. Their influence will motivate talented undergraduates to pursue research and enter Ph.D. programs. Successful researchers generally remember their undergraduate years and the influence it had on their decision to pursue post-graduate studies.

One might think that a Ph.D. program would shift faculty time away from the undergraduate program, but quite the opposite is true: the *lack* of a Ph.D. program steals time from the undergraduate program. Given the universality of Ph.D. programs at research institutions, the Department faculty are expected to have a certain level of productivity in order to obtain grants and promotions. With a master's student, a faculty member has to spend much time and effort getting the student up to speed only to generate perhaps one joint paper. A Ph.D. student requires hardly more effort and leads to a much longer and more fruitful collaboration. The lack of a Ph.D. program means that faculty have to take time away from undergraduates in order to train graduate students.

## 2.3 Job Market Prospects

Computer Science graduates earn some of the highest salaries among all college-level graduates. The benefits of a Computer Science degree for an undergraduate are well understood. Having a Ph.D. in Computer Science presents further benefits. The tremendous amount of resources being devoted to information sciences ensures that a Ph.D. in Computer Science will remain a major asset for many years. Upon graduation, a Ph.D. student can expect to find numerous research jobs in both academia and industry.

According to the 2005-2006 Taulbee Survey, Table 4, 26.0% of Ph.D. recipients find employment in North American Ph.D.-granting departments: 12.8% tenure-track, 2.6% researcher, 8.9% postdoc, and 1.7% teaching faculty. 5.2% find positions in other CS/CE departments. 49.4% find jobs in industry and 2.5% in government. Only 0.7% were unemployed. According to Table 27, the mean and median salary for NTT faculty was above $62,000. The mean and median salary for assistant professors was above $84,000. According to the 2002 Industrial Salary Survey of CS Research Labs (the latest available), the mean and median salary for a new Ph.D. was above $99,000.

Clearly, the demand for qualified researchers in Computer Science is high, and the prospects of a Ph.D. graduate in Computer Science are good.

# 3 Description

## 3.1 Exact Title of Degree

DOCTOR OF PHILOSOPHY IN COMPUTER SCIENCE

## 3.2 Overview

To earn a Ph.D. in Computer Science, a student must satisfy all the general requirements for a Ph.D. set by the graduate school: standardized tests, grade point average, residency, minimum credit distributions, *etc.* The following requirements are those which are specific to the Computer Science program. The goal of this program is to provide the Ph.D. student with both overall *breadth* in the field and *depth* in a particular area of concentration. To that end, the curriculum is broken into several categories:

- **A written qualifying examination** demonstrating advanced general knowledge (breadth) in Computer Science.
- **Course requirements** covering material in many areas, strengthening breadth, and extra course work in one particular area, strengthening depth.
- **Two research projects** building depth of knowledge in a particular field, as well as strengthening relationships between faculty and students for possible dissertation work.
- **Thesis proposal and defense**, accompanied by an oral exam to demonstrate significant depth in the chosen field.
- **Annual presentations** to demonstrate depth of knowledge, strengthen presentation skills, and provide a means of overseeing the student's progress.
- **Teaching experience** to strengthen both the student's presentation skills and the ability to explain materials in a coherent manner.

A Ph.D. student successfully completing the requirements in all of these categories will have demonstrated significant knowledge and understanding of the field of Computer Science and shall be deemed ready to use that knowledge in the broader community.

## 3.3 Admission Requirements

In order to be admitted to the Ph.D. program in Computer Science, an applicant must meet all of the requirements set by the Graduate School including adequate scores on the GREs. In addition, a minimum of 15 credits in Computer Science courses numbered 200 and above is required. Students may be admitted with deficiencies; these must be completed in addition to the degree requirements.

## 3.4 Ph.D. Degree Requirements

Upon completion of the curriculum, the student will have earned at least 60 credit hours beyond that of a bachelor's degree. Minimally, 12 credits will have come from dissertation research, 6 credits from research projects, and 24 credits from classroom courses. However, a typical student will have earned 24 credits from dissertation research, 12 credits from research projects, and 24 credits from classroom courses. At least 30 credits must be at the 600-level or higher. The student must also have obtained a minimum of 24 credits while in residence at UM. The Computer Science Graduate Committee (CSGC) maintains full authority over all decisions pertaining to a Ph.D. student. In particular, the acceptance of credits transferred by the student from another post-graduate institution shall be determined by the CSGC.

As specified by the Graduate School, degree requirements must be completed within eight years of the time of admission to graduate work and within four years of passing the qualifying examination. A Computer Science Ph.D. student shall be deemed to have passed the qualifying examination process upon completion of the written qualification examination and the research project requirements.

What follows is a more in-depth description of the categories, detailing the various criteria the student is expected to meet.

### Written Qualifying Exam

Every Ph.D. student must pass a three hour written exam of general knowledge of Computer Science at the end of the first year. Upon failure, the student may petition the CSGC to allow a second attempt at the end of the second year.

The exam will be administered once a year in the early weeks of the summer session. It will cover expected knowledge of all first-year graduate students. Included in this material are a fundamental understanding of algorithm analysis and design, advanced skills in programming, basic knowledge of computer architecture, and a general understanding of computer systems.

### Classroom Course Requirements

In the first two years, the student must take eight CSGC-approved classroom courses, for a total of 24 credits. At least four of these courses (12 credits) must be at the 600 level (only available to graduate students). The eight courses must include two courses from each of the areas of Analysis, Applications, and Systems. The student should work with his or her advisor to select a cohesive set of courses as approved by the CSGC.

The CSGC will have sole authority in designating the areas to which each course belongs. In the case that a course is designated in more than one area, a student may apply the course to only one area. The designation of current CSGC-approved courses appears in Section 3.5.

### Project Course Requirements

By the end of the second year the student must complete two graduate level project courses for a minimum total of 6 credits. Each project shall be under the supervision of a *different* faculty member in the Department.

All Ph.D. students must find faculty willing to supervise their project in the semester preceding the project. The deadline for finding a supervisor shall be the first full week in April or November for the Fall and Spring terms, respectively. This deadline does not require identifying a specific project but only finding a faculty member willing to supervise a project.

Upon completion of a project, the student must write a detailed project report. This report shall become a public document and shall be kept on file by the Department. The student must present the finished project to a quorum of the CSGC at a time to be approved by the chairman of the Department. The supervisor and CSGC must approve each project as applicable toward candidacy for a Ph.D. A primary factor in determining approval shall be the stated willingness of the supervisor to become an initial Ph.D. advisor for the student.

### Dissertation Committee, Proposal, and Defense

Upon completion of the two projects, the CSGC shall appoint a Dissertation Committee for the student as required by the Graduate School. The student must present a thesis proposal by the end of the fourth year. Both proposal and defense will include a public oral presentation followed by questioning from the Dissertation Committee.

### Development of Presentation Skills

After passing the written qualifying exam, the student must make a public oral presentation to the Department at least once per year. These presentations include the two project presentations, the thesis proposal, and the thesis defense. The goals are to develop the student's oral and presentation skills, to provide a means for the Department to check the research and progress of the student, and to present the opportunity for feedback to improve the student's research.

### Teaching Experience

Since Ph.D. graduates should be qualified to work in academia, each student must teach a lab-based course for a minimum of one semester. Lab-based courses introduce the student to working closely with both a faculty member and undergraduate students. These courses typically require the student to present material in a relaxed lecture format, re-emphasizing material learned in the general lecture as well as introducing new material to the students.

## 3.5 Approved Course Categories

The following is a list of approved courses for the classroom course requirements:

### Analysis

| | |
|---|---|
| CSC 506 | Logic |
| CSC 517 | Data Structures and Algorithm Analysis |
| CSC 518 | Compiler Theory |
| CSC 519 | Programming Languages |
| CSC 527 | Theory of Computing |
| CSC 531 | Introduction to Software Engineering |
| CSC 540 | Algorithm Design and Analysis |
| CSC 545 | Introduction to Artificial Intelligence |
| CSC 606 | Logic Programming |
| CSC 609 | Cryptography and Data Security |
| CSC 611 | Theory of Computation |
| CSC 612 | Theory of Complexity |
| CSC 623 | Theory of Relational Databases |
| CSC 628 | Parallel Algorithms |
| CSC 646 | Neural Computing |
| CSC 647 | Computational Geometry |
| EEN 656 | Information Theory |
| EEN 634 | Modeling and Analysis of Computer Networks |
| MTH 509 | Discrete Mathematics II |
| MTH 520 | Numerical Analysis I |
| MTH 521 | Numerical Analysis II |
| MTH 528 | Combinatorics |

### Applications

| | |
|---|---|
| CSC 523 | Principles of Filing and Database Systems |
| CSC 529 | Introduction to Computer Graphics |
| CSC 545 | Introduction to Artificial Intelligence |
| CSC 555 | Multimedia Systems |
| CSC 628 | Parallel Algorithms |
| CSC 645 | Expert System Design |
| CSC 646 | Neural Computing |
| CSC 648 | Automated Reasoning |
| CSC 655 | Advanced Multimedia Systems |
| EEN 638 | Computer Vision |
| MTH 520 | Numerical Analysis I |
| MTH 521 | Numerical Analysis II |

### Systems

| | |
|---|---|
| CSC 518 | Compiler Theory |
| CSC 519 | Programming Languages |
| CSC 521 | Principles of Computer Operating Systems |
| CSC 523 | Principles of Filing and Database Systems |
| CSC 524 | Networks and Information Security |
| CSC 555 | Multimedia Systems |
| CSC 609 | Cryptography and Data Security |
| CSC 645 | Expert System Design |
| CSC 655 | Advanced Multimedia Systems |
| EEN 514 | Computer Architecture |
| EEN 614 | Advanced Computer Architecture |
| EEN 534 | Computer Communication Networks |
| EEN 634 | Modeling and Analysis of Computer Networks |

## 3.6 Projected Program Size

Here is a conservative projected graduate program size.

| year | 1st | 2nd | 3rd | 4th | 5th |
|---|---|---|---|---|---|
| M.S. | 16 | 15 | 14 | 13 | 12 |
| Ph.D. | 2 | 4 | 6 | 8 | 10 |
| Total | 18 | 19 | 20 | 21 | 22 |

As resources are diverted from the master's program to the Ph.D. program, the number of master's students may decrease, but the total number of graduate students will increase.

# 4 Resources

The Department of Computer Science already has the resources to support the research of its faculty, its Master of Science program, and a Ph.D. program.

## 4.1 Teaching Assistantships

The Department has an allocation of seven teaching assistantships. Interdisciplinary Ph.D. students currently associated with the Department are also supported by individual faculty research funds, the university fellowship program, and the McKnight Fellowship program. Given the diversity of funding available for graduate students in Computer Science, no additional allocation of teaching assistantships is required.

## 4.2 Current Funding

Huseyin Kocak, Burt Rosenberg, Brian Coomes (Mathematics), $299,000, NSF.
Huseyin Kocak, RSMAS (F. Beron-Vera, M. Brown, M. Olascoaga), $900,000, NSF.
Victor Milenkovic, $240,000, NSF.
Dilip Sarkar, $27,650, University of Miami Small Grant.
Geoff Sutcliffe, $20000, Unrestricted gift to the University of Miami in support of Research in Automated Reasoning, Articulate Software.
Geoff Sutcliffe (PI), Huseyin Kocak (co-PI), Burt Rosenberg (co-PI), Victor Pestien (co-PI) (Mathematics), $467575, Computer Science and Mathematics for Scientists, NSF Scholarships in Science, Technology, Engineering, and Mathematics.
Geoff Sutcliffe, $1500, Unrestricted gift to the University of Miami in support of the CADE-21 Workshop on Empirically Successful Automated Reasoning in Large Theories, Microsoft Research.
Geoff Sutcliffe (host), Josef Urban (researcher), Euro 176076, Automating Reasoning in Large Formal Mathematical Knowledge Bases, European Union Marie Curie Outgoing International Fellowship.

Please see Curriculum Vitae for details.

## 4.3 External Funding

Having Ph.D. students and obtaining external funding are corequisites. We expect both to increase as the Department grows. According to Table 24-2 from the 2004-2005 and 2005-2006 Taulbee Survey, mean expenditure from external sources per tenure-track faculty is above $100,000 per year even for universities ranked below the top 36. The lion's share of this money goes to support Ph.D. students.

**NOTE**: The program is *not* dependent on external funding to get started. With seven teaching assistantships available, we can afford to provide each faculty member with a Ph.D. student to work with. This is enough for a good faculty member to "bootstrap" to an externally funded research program.

## 4.4 Equipment

The College of Arts and Sciences recently committed resources to a significant equipment upgrade:

- One classroom lab with 20 UNIX workstations, instructor's workstation, projector, and screen.
- One research/learning lab with 6 UNIX Workstations and 6 Windows PCs.
- Machine room housing servers and network equipment for the labs, faculty email, and the departmental web page and a firewall.
- Desktop PC, bootable in UNIX or Windows, for each teaching assistant.
- Computational cluster with 12 processors and 2 servers.

In addition to the general labs available to students, the Department already has an equipped lab with several machines and accessories for multimedia research and development.

The Department provides a desktop computer to each fellowship recipient.

## 4.5 Information Resources

The Department has sufficient access to resources through the University's Richter Library and online resources. The library's holdings are also expected to expand as new faculty with new areas of interest join the Department. The Department has an additional $7,000 annual budget with the library to purchase any materials not automatically acquired by the library.

In addition, many relevant journals and other resources are easily available online through the library's online subscriptions to publishers such as IEEE and the ACM digital library. This is extremely important in the Computer Science field, as most current research is being made available online quicker and more cost effectively than in printed format.

Section 4.6 lists the current Computer Science journal holdings at the library.

## 4.6 Journal Title Holdings

The following is a list of the current journal title holdings for Computer Science at the University of Miami's Richter Library:

A & I and Society
ACM Journal of Computer Documentation
ACM Letters on Programming Languages and Systems
ACM Sigplan Notices
ACM Transactions on Computational Logic
ACM Transactions on Computer Systems
ACM Transactions on Database Systems
ACM Transactions on Human Computer Interaction
ACM Transactions on Mathematical Software
ACM Transactions on Modeling and Computer Simulation
ACM Transactions on Programming Languages and Systems
ACM Transactions on Software Engineering and Methodology
Acta Informatica
AI Magazine
Algorithmica
Annals of Mathematics and AI
Applied Mathematics and Computation
Artificial Intelligence
BIT
BYTE
Combinatorics, Probability and Computing
Communications of the ACM
Computational Complexity
Computational Intelligence
Computer
Computer Aided Geometric Design
Computer Architecture News
Computer Communication
Computer Design
Computer Journal
Computer Languages
Computers and Mathematics with Applications
Computers and Security
Computing
Cybernetics
Database Programming
Distributed Computing
Expert Systems
Formal Aspects of Computing
Fundamenta Informaticae
Future Generation Computer Systems
Fuzzy Sets and Systems
IEEE Concurrency
IEEE Internet Computing
IEEE Micro - Chips, Systems, Software and Applications
IEEE Multimedia
IEEE Software
IEEE Transactions on Multimedia
IEEE Transactions of Information Theory
IEEE Transactions on Evolutionary Computation
IEEE Transactions on Fuzzy Systems
IEEE Transactions on Knowledge and Data Engineering
IEEE Transactions on Neural Networks
IEEE Transactions on Parallel and Distributed Systems
IEEE Transactions on Pattern Analysis and Machine Intelligence
IEEE Transactions on Software Engineering
IEEE Transactions on Systems, Man and Cybernetics ; Part A and B
Information and Computation
Information Processing Letters
Information Systems Research
Interacting With Computers
International Journal of Computational Geometry and Applications
International Journal of Foundations of Computer Science
International Journal of Human Computer Interaction
International Journal of Parallel Programming
International Journal of Systems Science
Journal of Algorithms
Journal of Automated Reasoning
Journal of Computation and Applied Mathematics
Journal of Computational Analysis
Journal of Computer and System Sciences
Journal of Computer Information Systems
Journal of Cryptology
Journal of Database Management
Journal of End-User Computing
Journal of Functional Programming
Journal of Logic and Computation
Journal of Logic Programming
Journal of Network and Computer Applications
Journal of Object Oriented Programming
Journal of Parallel and Distributed Computing
Journal of Scientific Computing
Journal of System Architecture
Journal of Systems and Software
Journal of Systems Architecture
Journal of the ACM
Journal of Visual Languages and Computing
Knowledge and Information Systems
Knowledge Based Systems
Linux Journal
Mathematical and Computer Modeling
Mathematical Programming
Mathematical Structures in Computer Science
Mathematics and Computer Education
Mathematics and Computers in Simulation
Mathematics of Computation
Microcomputer Applications
Multimedia Systems
Network: Computation in Neural Systems
Neural Computing and Applications
Neural Networks
Parallel Computing
Parallel Processing Letters
Pattern Recognition
Problems of Information Transmission
Programming and Computer Software
Random Structures and Algorithms
SIAM Journal on Computing
SIAM Journal on Scientific Computing
SIGMOD Record
Soft Computing
Software Concepts and Tools
Software Engineering Notes
Software Practice and Experience
Software Testing, Verification and Reliability
Systems and Control Letters
Theoretical Computer Science
Unix Review
Virtual Reality
Visual Computer
VLDB International Journal on Very Large Databases

# 5 Graduate Faculty

## Dr. Huseyin Kocak, Professor and Chairman

Ph.D. in Mathematics, 1980, University of California at Santa Cruz.
**Research Interests:** Dynamical Systems and their applications to biology, ecology and medicine; Scientific Computing, Visualization.
**Students:** Huseyin has advised and/or served on the committees of several dozen Master's and Doctoral students from The College of Arts and Sciences, School of Engineering, School of Atmospheric and Marine Sciences, and the former School of International Studies. Currently, he is advising an interdisciplinary Ph.D. thesis in Computer Science of McKnight Fellow Morgan Johnson and the Master's Thesis of Craig Kolthoff of the IT department.

## Dr. Thomas LeBlanc, Professor Executive Vice President and Provost

Thomas J. LeBlanc, executive vice president and provost, was appointed in 2005. He is the chief academic officer and chief budget officer for the University and is responsible for overseeing and coordinating academic programs and enhancing the educational mission of the University. He is also a professor in the Departments of Computer Science and Electrical and Computer Engineering. Previously, LeBlanc served as dean of the college faculty in the College of Arts, Sciences, and Engineering at the University of Rochester. His publications include writings on operating systems, parallel programming, and software engineering. He holds a Ph.D. and a master's degree in Computer Science from the University of Wisconsin at Madison and a Bachelor of Science in Computer Science from State University of New York at Plattsburgh [http://www6.miami.edu/UMH/CDA/UMH_Main/0,1770,2472-1;46573-3,00.html].

## Dr. Victor Milenkovic, Professor

Ph.D., 1988, Carnegie Mellon University.
**Research Interests:** Computational Geometry, Layout, Graphics, Numerical Issues, Computational Chemistry.
**Students:** Victor has graduated two Computer Science Ph.D. students at Harvard University, one of whom, Karen Daniels, is now a tenured associate professor, and one interdepartmental Ph.D. students at UM: Harald Schmidl. He has advised and served on the committees of numerous master's degree students. He is currently advising and funding interdepartmental PhD. student Steven Trac on an NSF grant and hopes to transition Steven to the new Ph.D. program.

### Dr. Shahriar Negahdaripour, Secondary Appointment, Professor of Electrical and Computer Engineering

Ph.D. Electrical Engineering, 1987, MIT.
**Research Interests:** Underwater Vision and Imaging.
**Active Projects:** 1) Integrated high-precision opti-acoustic imaging and positioning platform for underwater search and inspection, ONR DURIP, June'06- June'07. 2) Investigation of Multiple-View 3-D Reconstruction Methods with FS Sonar Video Cameras ONR, June'05- April'08.

### Dr. Mitsunori Ogihara, Professor

Ph.D. Information Technology, 1993, Tokyo Institute of Technology.
**Research Interests:** Computational Complexity, Molecular Computation, Data-Mining, Bioinformatics.
**Students:** Alina Beygelzimer (PhD: 2003), Yin-He Cheng (PhD: 2004), Gabriel Istrate (PhD: 1999), Ashwin Lall (expected defense: May, 2008), Tao Li (PhD: 2004), Srinivasan Parthasarathy (PhD: 1999), Bin Wei (expected defense: May, 2010). Mohammed Javeed Zaki (PhD: 1998), Chengliang Zhang (expected defense: July, 2007).

### Dimitris Papamichail, Assistant Professor

Ph.D., 2007, SUNY at Stony Brook.
**Research Interests:** Bioinformatics, algorithms and data structures, optimization, decision support systems.

### Dr. Victor Pestien, Secondary Appointment, Associate Professor of Mathematics

Ph.D. Mathematics, 1980, University of California at Berkeley.
**Research Interests:** Probability, Optimization.
**Students** (Ph.D., Mathematics): Michael G. Monticino, "The adequacy of measurable and of stationary strategies for approximating optimal return", Mathematics and Computer Science, University of Miami, May, 1987. Xiaobo Wang, "Reward functions and Markov strategies in finite-stage stochastic decision problems", Mathematics and Computer Science, University of Miami, July, 1992. Kevin R. Ruth, "Favorable red and black on the integers with a minimum wager9', Mathematics and Computer Science, University of Miami, December, 1999.

## Dr. Subramanian Ramakrishnan, Secondary Appointment, Associate Professor of Mathematics

Ph.D. Mathematics, 1980, Indian Statistical Institute
**Research Interests:** Probability, Statistics.
**Students** (Mathematics): Carlos Canas, DA project, Queueing Networks in Discrete-time: Exact results and Approximations, 2004. 2) John Beam, Ph.D. thesis, Expectations for Coherent probabilities, 2002.

## Dr. Burton Rosenberg, Associate Professor and Director of Technology

Ph.D., 1991, Princeton University.
**Research Interests:** Cryptography and security; scientific visualization and computation; mathematical finance.
**Students:** Launched webmail project with undergraduate Matt Mankins. Eventually sold as emumail, www.emumail.com. Advised one master's student, served on the committee for six other master students.

## Dr. Dilip Sarkar, Associate Professor and Director of Graduate Studies

Ph.D., 1988, University of Central Florida.
**Research Interests:** High-speed Networks, Mobile and Wireless Computing, Multimedia Communication and Systems, QoS on the Web
**Students:** Dilip is supervising two interdisciplinary Ph.D. students at UM: Wing Tong and Wei Zhou. He is also advising three master's students. In the past, Dilip has advised 25 master's degree students and served on the committees for several master's and Ph.D. degree students.

## Dr. Geoff Sutcliffe, Associate Professor and Director of Undergraduate Studies

Ph.D., 1992, The University of Western Australia.
**Research Interests:** Automated Theorem Proving (ATP), Evaluation of ATP Systems, Distributed and Parallel ATP
**Students:**
2005-2006 MS Supervisor, Shen W., Automated Proofs of Relationships Between Modal Logic Systems, University of Miami.
2004-2006 MS Supervisor, Moynihan K., Lascaux - An Intelligent Artistic Agent, University of Miami.
2003-2005 MS Supervisor, Zhang Y., The Use of Lemmas for Solving Hard Automated Theorem Proving Problems, University of Miami.

2003-2004 MS Supervisor, Gao Y., Automated Generation of Interesting Theorems, University of Miami.

1998-2003 MSc Supervisor, Brown M., Semantic Guidance for Linear ATP Systems, James Cook University.

1994 MSc Supervisor, Nugroho L., A Programmer's Tool for Managing Persistent Object Structures, James Cook University.

1990 MAppSc Supervisor, Tabada W., An Analysis and Implementation of Linear Derivation Strategies, Edith Cowan University.

# 6 Bulletin Description

This is the proposed bulletin description for the Ph.D. program.

### Doctor of Philosophy in Computer Science

The following requirements are in addition to the general requirements for the Doctor of Philosophy Degree as described by the Graduate School. The Computer Science Graduate Committee (CSGC) maintains full authority over all decisions pertaining to a Ph.D. student.

1. **Admission Requirements:** In order to be admitted to the Ph.D. program in Computer Science, an applicant must have obtained a minimum of 15 credits in Computer Science courses numbered 200 and above. Applicants may be admitted with deficiencies; these must be completed in addition to the degree requirements.

2. **Written Qualifying Exam:** The student must pass a three-hour written exam of general knowledge of Computer Science at the end of the first year. Upon failure, the student may petition the CSGC to allow a second attempt at the end of the second year.

   The exam will be administered once a year in the early weeks of the summer session. It will cover expected knowledge of all first-year graduate students. Included in this material are a fundamental understanding of algorithm analysis and design, advanced skills in programming, basic knowledge of computer architecture, and a general understanding of computer systems.

3. **Classroom Course Requirements:** In the first two years, the student must take eight CSGC-approved classroom courses, for a total of 24 credits. At least four of these courses (12 credits) must be at the 600 level. The eight courses must include two courses from each of the areas of Analysis, Applications, and Systems. The student should work with his or her advisor to select a cohesive set of courses as approved by the CSGC.

   The CSGC will have sole authority in designating the areas to which each course belongs. In the case that a course is designated in more than one area, a student may apply the course to only one area. The designation of current CSGC-approved courses appears at the end of this description.

4. **Project Course Requirements:** By the end of the second year the student must complete two graduate level project courses for a minimum total of 6 credits. Each project shall be under the supervision of a *different* faculty member in the Department.

   All Ph.D. students must find faculty willing to supervise their project in the semester preceding the project. The deadline for finding a supervisor shall be the first full week in April or November for the Fall and Spring terms, respectively. This deadline does not require identifying a specific project but only finding a faculty member willing to supervise a project.

Upon completion of a project, the student must write a detailed project report. This report shall become a public document and shall be kept on file by the Department. The student must present the finished project to a quorum of the CSGC at a time to be approved by the chairman of the Department. The supervisor and CSGC must approve each project as applicable toward candidacy for a Ph.D. A primary factor in determining approval shall be the stated willingness of the supervisor to become an initial Ph.D. advisor for the student.

5. **Annual Presentations:** After passing the written qualifying exam, the student must make a public oral presentation to the Department at least once per year. These presentations include the two project presentations, the thesis proposal, and the thesis defense. The goals are to develop the student's oral and presentation skills, to provide a means for the Department to check the research and progress of the student, and to present the opportunity for feedback to improve the student's research.

6. **Teaching Experience:** Each student must teach a lab-based course for a minimum of one semester. Lab-based courses typically require the student to present material in a relaxed lecture format, re-emphasizing material learned in the general lecture as well as introducing new material to the students.

## Approved Course Categories

The following is a list of approved courses for each of the three categories:

### Analysis

| | |
|---|---|
| CSC 506 | Logic |
| CSC 517 | Data Structures and Algorithm Analysis |
| CSC 518 | Compiler Theory |
| CSC 519 | Programming Languages |
| CSC 527 | Theory of Computing |
| CSC 531 | Introduction to Software Engineering |
| CSC 540 | Algorithm Design and Analysis |
| CSC 545 | Introduction to Artificial Intelligence |
| CSC 606 | Logic Programming |
| CSC 609 | Cryptography and Data Security |
| CSC 611 | Theory of Computation |
| CSC 612 | Theory of Complexity |
| CSC 623 | Theory of Relational Databases |
| CSC 628 | Parallel Algorithms |
| CSC 646 | Neural Computing |
| CSC 647 | Computational Geometry |
| EEN 656 | Information Theory |
| EEN 634 | Modeling and Analysis of Computer Networks |
| MTH 509 | Discrete Mathematics II |
| MTH 520 | Numerical Analysis I |
| MTH 521 | Numerical Analysis II |
| MTH 528 | Combinatorics |

### Applications

| | |
|---|---|
| CSC 523 | Principles of Filing and Database Systems |
| CSC 529 | Introduction to Computer Graphics |
| CSC 545 | Introduction to Artificial Intelligence |
| CSC 555 | Multimedia Systems |
| CSC 628 | Parallel Algorithms |
| CSC 645 | Expert System Design |
| CSC 646 | Neural Computing |
| CSC 648 | Automated Reasoning |
| CSC 655 | Advanced Multimedia Systems |
| EEN 638 | Computer Vision |
| MTH 520 | Numerical Analysis I |
| MTH 521 | Numerical Analysis II |

## Systems

| | |
|---|---|
| CSC 518 | Compiler Theory |
| CSC 519 | Programming Languages |
| CSC 521 | Principles of Computer Operating Systems |
| CSC 523 | Principles of Filing and Database Systems |
| CSC 524 | Networks and Information Security |
| CSC 555 | Multimedia Systems |
| CSC 609 | Cryptography and Data Security |
| CSC 645 | Expert System Design |
| CSC 655 | Advanced Multimedia Systems |
| EEN 514 | Computer Architecture |
| EEN 614 | Advanced Computer Architecture |
| EEN 534 | Computer Communication Networks |
| EEN 634 | Modeling and Analysis of Computer Networks |

# 7 Questions and Answers

Q: Are the courses in place to offer a Ph.D. and are they being taught?
A: Yes and yes. Our master's program is unashamedly research-oriented and we graduate many master's students each year, many of whom write master's theses that are published in journals. No new courses are planned for the Ph.D. program, nor do we plan to change the frequency. Section 8 provides data on the number of master's degrees bestowed in the past five years. Section 8 also provides data on past and planned future course offerings at the undergraduate and graduate level.

Q: How will we support the new Ph.D. students?
A: The department is able to award seven teaching assistantships to highly qualified students. Currently, we can only offer these to master's students. Obviously, we will also seek funding from outside the university for research assistantships. There is a shortage of Ph.D.s in Computer Science, and there is much external funding available for graduate work.

Q: What about the $100,000/year/faculty external funding?
A: A mature, successful Ph.D. program is *necessary* to reach this national average, but it is not necessarily *sufficient*. It is mere speculation that we will ever reach this level of external funding. *Instead,* this proposal is based solidly on past performance and current resources.

Q: Won't the number of master's students decrease as a result of shifting the resources?
A: Possibly but gradually: we plan to be very selective in the admission of Ph.D. students, leaving the remaining teaching assistantships for highly qualified master's students as before.

Q: Shouldn't we hire a few more faculty before establishing a Ph.D. program?
A: By requiring that student do research projects with two different faculty for candidacy, the new program is specifically designed to avoid "orphaning". Furthermore, with an established record of assigning teaching assistantships to master's students, we can afford to offer assistantships only to those Ph.D. applicants whose interests closely fit those of the faculty. Since a significant portion of potential *faculty* applicants will eschew a university without a Ph.D. program, perhaps the question should be, "Shouldn't we establish a Ph.D. program before hiring more faculty?"

Q: Won't the new Ph.D. program steal faculty time away from the undergraduates?
A: Again, quite the opposite: the *lack* of a Ph.D. program steals time from the undergraduate program. Given the universality of Ph.D. programs at research institutions, our faculty are expected to have a certain level of productivity in order to obtain grants and promotions. With a master's student, a faculty member has to spend much time and effort getting the student up to speed only to generate perhaps one joint paper. A Ph.D. student requires hardly more effort and leads to a much longer and more fruitful collaboration. So basically, the lack of a Ph.D. program means that faculty have to take time away from undergraduates in order to train graduate students.

Q: How does this program relate to those provided by the universities listed in Section 8?
A: For the most part, the program follows that of Johns Hopkins, also a young department. It

Table 1: Comparison of proposed program with several AAU universities. JHU=The Johns Hopkins University; UNC=The University of North Carolina at Chapel Hill; UFL=University of Florida, Gainesville.

| | UM | JHU | Duke | UNC | UFL |
|---|---|---|---|---|---|
| concentration courses | 2 | 2 | 4 | 3 | 4 |
| breadth courses | 6 | 6 | 4 | 6 | 6 |
| project courses | 2 | 2 | 0 | 0 | 0 |
| annual presentations | yes | yes | no | no | no |
| attend colloquia | no | yes | no | yes | yes |
| teaching | yes | yes | no | no | yes |
| written qualifier | yes | no | yes | yes | yes |
| oral qualifier | no | yes | no | yes | no |

requires courses in three areas–Analysis, Applications, and Systems–and it requires projects with two different faculty members. Table 7 compares the proposed program to Ph.D. programs at JHU and other nearby AAU universities. We note that many departments require attendance at colloquia. The Computer Science Department currently requires graduate students to attend as a condition of receiving a teaching assistantship.

# 8 Additional Supporting Materials

1. Approval of College of Arts and Sciences, November 16, 2004.
2. Total number of MS degrees awarded in the last five years.
3. Undergraduate and graduate teaching of computer science courses: 1994-2000.
4. Undergraduate and graduate teaching of computer science courses: 2000-2007 (anticipated).
5. CV: Huseyin Kocak
6. CV: Thomas LeBlanc
7. CV: Victor J. Milenkovic.
8. CV: Shahriar Negahdaripour
9. CV: Mitsunori Ogihara
10. CV: Dimitris Papamichail
11. CV: Victor Pestien
12. CV: Subramanian Ramakrishnan
13. CV: Burton Rosenberg.
14. CV: Dilip Sarkar.
15. CV: Geoff Sutcliffe.
16. 2005-2006 CRA Taulbee Survey.
17. 2004-2005 CRA Taulbee Survey.
18. 2001-2002 Industry Salary Survey
19. CRA Forsythe List of Ph.D.-granting departments.
20. List of Florida Ph.D.-granting departments.
21. Johns Hopkins University (CS Dept), Program for Ph.D. students.
22. Duke University (CS Dept), Program for Ph.D. students.
23. University of North Carolina (CS Dept), Program for Ph.D. students.
24. University of Florida (CS Dept), Program for Ph.D. students.

25. Graduate Education in Computational Science and Engineering. *SIAM Review*, Volume 43, Number 1, pp. 163-177.

26. Proposal to the Faculty Senate to establish a new Department of Computer Science, approved January 1999.

UNIVERSITY OF Miami

**MEMORANDUM**

March 10, 2008

TO: Faculty Senate

FROM: Hüseyin Koçak
Chair, Department of Computer Science

SUBJECT: Ph.D. Program in Computer Science

This memo serves to confirm that the Department of Computer Sciences faculty unanimously approved the Ph.D. Program in Computer Science. The proposal is now forwarded to the Faculty Senate for action. No additional funds are being requested for the successful implementation of the proposed Ph.D. program in Computer Science.

Department of Computer Science
College of Arts & Sciences
P.O. Box 248154
Coral Gables, Florida 33124-4245
305-284-2268
Fax: 305-284-2264

## Faculty Senate Office

**From:** Faculty Senate Office
**Sent:** Monday, April 07, 2008 3:11 PM
**To:** Kocak, Huseyin
**Cc:** Garcia, Julieta
**Subject:** legislation approved by the PResident

Below is a link to your copy of legislation that has been approved by the President:

Legislation # 2007-40(B)- College of Arts and Science Establishment of a Doctor of Philosophy (PhD) in Computer Science (This has been forwarded to the Board of Trustees for their approval)

Regards,

Robyn

Faculty Senate Office
University of Miami
325 Ashe Administration Building
1252 Memorial Drive
Coral Gables, FL 33146
(305) 284-3721
Fax: (305) 284-5515
www.miami.edu/fs

## Faculty Senate Office

**From:** Faculty Senate Office
**Sent:** Monday, April 07, 2008 2:47 PM
**To:** Freyre, Maria Beatriz
**Subject:** Your copy of approved legislation

Hi Betty,
Below are links to Dr. Birnbach's copies of Legislation that has been approved by the President:

Legislation # 2007-39(B)- Miami Institute for Human Genomics (MHIG) at the Miller School of Medicine

Legislation # 2007-40(B)- College of Arts and Science Establishment of a Doctor of Philosophy (PhD) in Computer Science

Legislation # 2007-41(B) - School of Architecture Establishment of a Master Degree in Real Estate Development and Urbanism ( MRED& U)

Legislation # 2007-43 (B)- Move of the Master of Public Administration from the School of Business Administration to the College of Arts & Sciences

Thanks,

Robyn

Faculty Senate Office
University of Miami
325 Ashe Administration Building
1252 Memorial Drive
Coral Gables, FL 33146
(305) 284-3721
Fax: (305) 284-5515
www.miami.edu/fs

## Faculty Senate Office

**From:** Faculty Senate Office
**Sent:** Monday, April 07, 2008 3:09 PM
**To:** Halleran, Michael Ros
**Cc:** Glemaud, Rose-Ketlie
**Subject:** legislation approved by the President

Attached are your copies of legislation that has been approved by the President:

Legislation # 2007-40(B)- College of Arts and Science Establishment of a Doctor of Philosophy (PhD) in Computer Science (This has been forwarded to the Board of Trustees for their approval)

Legislation # 2007-43 (B)- Move of the Master of Public Administration from the School of Business Administration to the College of Arts & Sciences

Regards,

Robyn

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325 Ashe Administration Building
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Coral Gables, FL 33146
(305) 284-3721
Fax: (305) 284-5515
www.miami.edu/fs

## Faculty Senate Office

**From:** Faculty Senate Office
**Sent:** Monday, April 07, 2008 2:57 PM
**To:** Scandura, Teresa Anne
**Cc:** Rowand, Michele M
**Subject:** approved legislation

Attached are the links to your copies of legislation that has been approved by the President:

Legislation # 2007-40(B)- College of Arts and Science Establishment of a Doctor of Philosophy (PhD) in Computer Science (this has been forwarded to the Board of Trustees for their approval)

Legislation # 2007-41(B) - School of Architecture Establishment of a Master Degree in Real Estate Development and Urbanism ( MRED& U) (this has been forwarded to the Board of Trustees for their approval)

Legislation # 2007-43 (B)- Move of the Master of Public Administration from the School of Business Administration to the College of Arts & Sciences

Thanks,

Robyn

Faculty Senate Office
University of Miami
325 Ashe Administration Building
1252 Memorial Drive
Coral Gables, FL 33146
(305) 284-3721
Fax: (305) 284-5515
www.miami.edu/fs

## Faculty Senate Office

**From:** Faculty Senate Office
**Sent:** Tuesday, April 01, 2008 6:05 PM
**To:** Glemaud, Rose-Ketlie
**Subject:** FW: Legislation #2007-40(B)
**Attachments:** 2007-40B.pdf

Forgot to cc you,
Sorry,
Robyn

Faculty Sentate Office
University of Miami
325 Ashe Administration Building
1252 Memorial Drive
Coral Gables, FL 33146
(305) 284-3721
Fax: (305) 284-5515
www.miami.edu/fs

-----Original Message-----
From: Faculty Senate Office
Sent: Tuesday, April 01, 2008 3:57 PM
To: Birnbach, David J; Halleran, Michael Ros; Scandura, Teresa Anne; Kocak, Huseyin
Cc: Garcia, Julieta
Subject: Legislation #2007-40(B)

Attached is your copy of Legislation 2007-40(B) - College of Arts and Science Establishment of a Doctor of Philosophy (PhD) in Computer Science which is pending based on approval by the President. You will be sent a copy of the legislation once it has been approved by the President and the Board of Trustees.

Regards,
Robyn Hardeman

Faculty Sentate Office
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