

Ph.D. Program  
**Computer Science and Informatics**

**Concentrations**

*Computer Science*  
*Software and Information Technology*

**Proposed Start Date: Fall 2007**

**Department of Computer Science and Engineering**  
**School of Engineering and Computer Science**  
**Oakland University**

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## Summary

In the United States, the enterprise of higher education has experienced steady growth during the past century. This has created opportunities for talented individuals seeking advanced degrees. In 1993, over 300 universities offered a Ph.D. or related doctoral research degree in many fields of sciences, engineering, and arts & humanities, and awarding over 39,000 doctoral degrees that year. In order to reap the full benefit of advanced education, scholars and administrators have been prompted from time to time to examine the quality of doctoral programs available to students. The Computer Science and Engineering department has undertaken a similar endeavor and hereby proposes to offer a doctoral degree in Computer Science and Informatics with specialization tracks in (1) Computer Science, and (2) Software and Information Technology.

The Systems Engineering doctoral program is currently available to our students through the Dean of the School of Engineering and Computer Science. This program is now over 30 years old and no longer adequately reflects the variety and maturity of the research conducted by the students enrolled in the Computer Science and Engineering department. The proposed Ph.D. program represents a restructuring of the Computer Science and Engineering subset of the Systems Engineering doctoral degree to address the needs of our department and to adequately meet the expectations of our constituents.

The growth of the computing field has resulted in increasing demand for highly specialized workers in the software engineering and information technology fields. This has created a need for research oriented careers – a need that must be fulfilled by Oakland to keep pace with programmatic changes being incorporated nationally as well as by other comparable universities in the State of Michigan.

The role and mission of Oakland University identifies four essential ingredients for our continued success: excellent and relevant instruction, high quality basic and applied research and scholarship, responsive and effective public and community service and a comprehensive schedule of student development activities. The proposed Ph.D. program in Computer Science and Engineering helps us pursue these goals more effectively. The program will help us provide excellent instruction through the introduction of new courses and help us achieve excellence in research and scholarship through the pursuit of discipline focused research in the computing field. Furthermore, as evidenced through the overwhelming support by the letters from our constituents, the proposed program is directly responsive to the needs of our local industry and therefore well serves our immediate community, region, state and the nation.

The Department of Computer Science and Engineering has 15 faculty members; most have active and well-funded research programs. They actively supervise Ph.D. students under the current Systems Engineering program with specialization areas of Software Engineering, Intelligent Systems, Database Systems, Networking, Multimedia, and Bioinformatics as well as other interdisciplinary fields. Given the broad expertise of its faculty, the department is capable of developing a stronger Ph.D. program in Computer Science and Informatics to better serve the needs of our students. The proposed program enables us to compete nationally and internationally in attracting good doctoral students and researchers to Oakland University.

It is worth noting that our proposal continues a previous effort towards such a restructuring. The basis for such a process was established through the introduction of a Ph.D. in Mechanical Engineering in 2001. Thus, our proposal represents a natural continuation of this process.

The benefit of this new doctoral program will be threefold. Firstly, it will provide a better definition, focus and clarity for the doctoral degree students and help us

attract high caliber students. Secondly, a doctoral degree in Computer Science and Informatics will *truly* represent the knowledge, preparation and training received by the students graduating from the Computer Science and Engineering department. And thirdly, it will enable our doctoral students to compete effectively for jobs that require a Ph.D. in Computer Science where they currently have to sell their Systems Engineering degree to qualify for CS-focused research positions.

# Contents

<b>1</b>	<b>Rationale</b>	<b>1</b>
1.1	Need for the Program. Why now? . . . . .	1
1.2	Intellectual Resources . . . . .	2
1.3	Benefit to the University and the Community . . . . .	3
1.4	Structure of the Program . . . . .	5
1.5	Goals of the Programs . . . . .	6
1.6	Source of Students . . . . .	8
1.7	Comparison to Other Programs in Michigan . . . . .	9
<b>2</b>	<b>Current Status</b>	<b>11</b>
2.1	Relationship to Systems Engineering . . . . .	11
2.2	Goals of the Unit Served by the Program . . . . .	12
2.3	Faculty Qualifications and Departmental Strengths . . . . .	12
2.4	Library Holdings . . . . .	14
2.5	Laboratories and Equipment . . . . .	17
2.6	Impact on the Current Programs . . . . .	19
<b>3</b>	<b>Doctoral Program Plan</b>	<b>21</b>
3.1	Admission Requirements . . . . .	22
3.2	Degree Requirements . . . . .	23
3.3	Coursework Requirements . . . . .	25

3.3.1	Foundation Coursework . . . . .	25
3.3.2	Advanced Mathematics Course . . . . .	26
3.3.3	Electives . . . . .	26
3.4	Qualifying Examinations . . . . .	27
3.4.1	Core Examination . . . . .	27
3.4.2	Option Examinations . . . . .	28
3.4.3	Oral Examination . . . . .	29
3.5	Teaching Experience Requirement . . . . .	29
3.6	Recruitment Plan . . . . .	30
<b>4</b>	<b>Needs and Costs of the program</b>	<b>33</b>
<b>5</b>	<b>Course Description</b>	<b>36</b>
<b>6</b>	<b>Conclusions</b>	<b>44</b>
<b>7</b>	<b>Plans for Assessment</b>	<b>45</b>
<b>8</b>	<b>Student Surveys</b>	<b>46</b>
<b>9</b>	<b>Faculty Vitas</b>	<b>49</b>
<b>10</b>	<b>Letters of Support</b>	<b>50</b>

# 1 Rationale

## 1.1 Need for the Program. Why now?

The growth of *computing* has resulted in an increasing demand for highly specialized workers in software and information technology fields. This has created a market for research oriented careers – a need that must be fulfilled by our university to keep pace with programmatic changes being incorporated nationally as well as by other comparable universities in the State of Michigan.

The School of Engineering and Computer Science introduced a Systems Engineering Doctoral program in 1972 to meet the needs of the manufacturing and automotive sectors during an era when manufacturing research was at its helm. In its 30-year existence, the Ph.D. in Systems Engineering program served well the needs of the students, the university and the country. However, the computing field and the community have outgrown the original purpose of this doctoral program. Therefore, it is incumbent upon us to address the needs of our constituents and provide focused doctoral degree program in the area of computer science, software engineering and information technology.

The field of computer science and engineering is continuing to evolve rapidly. From a non-field 30 years ago, it is now a fully developed discipline with many areas of specialty. including information technology, software engineering, intelligent systems, networking, and multimedia to name a few. The demand for highly qualified researchers in these fields continues to rise. Such a focused demand is no longer being

adequately satisfied by the Systems Engineering program when our graduates are incorrectly (through *mislabeling* of their doctoral degrees) perceived to be lacking in training and research experience in core computing competencies. For this reason, the department needs a dedicated programs which is reflective of ongoing research in the department of Computer Science and Engineering. Such a program will also be more responsive to the growth and evolution of the computing field.

In fact, the Mechanical Engineering Department broke away from the System Engineering umbrella and led the way by starting its own doctoral program in 2001. This program has been very successful in and competes nationally to attract good doctoral students. Furthermore, not only has the number of doctoral students in the Mechanical Engineering department grown since in the introduction of the new program, this growth has occurred *without* a corresponding attrition in the number of students in the Systems Engineering.

At present, the doctoral students in Computer Science and Engineering receive a degree in Systems Engineering. Our proposal to introduce a new Ph.D. program in Computer Science and Informatics represents a similar endeavor to break away from the mold and provide an appropriate forum for cutting edge research in computing.

## **1.2 Intellectual Resources**

The CSE department has adequate intellectual resources necessary to develop and oversee a dedicated doctoral program. It has 15 faculty members with active and well-funded research programs in areas of high demand by students and industry.

Faculty in the CSE department currently advise Ph.D. students in Systems Engineering. On an average at any given time, approximately 30-40 students are advised by CSE faculty on various contemporary research topics in Computer Science and Information Technology. The Computer Science and Engineering Department also has 300–400 undergraduates, 200–300 master’s and 30-40 doctoral students. The department has well-funded research and a well-developed with a variety of research laboratories and graduate course offerings. The research focus runs through all levels of the student body with very active NSF sponsored programs such as the Research Experience for Undergraduates (REU) now in its fifth year and the NSF/NIH Summer Institute in Biological and Health Informatics (SIBHI) initiated in 2006. The students participating in these programs are recruited from across the county.

With the availability of a doctoral program in Computer Science and Informatics, this would uniquely position our department by providing us tremendously improved visibility and make Oakland a viable choice for these exceptionally bright undergraduate students to undergo fast-track research program leading towards a doctoral degree in Computer Science and Informatics.

### **1.3 Benefit to the University and the Community**

The role and mission of the university identifies four essential ingredients: excellent and relevant instruction, high-quality basic and applied research and scholarship, responsive and effective public and community service and a comprehensive schedule of student development activities.

The proposed Ph.D. program in Computer Science and Engineering is consistent with the role and mission of Oakland University. It will provide excellent instruction in a focused discipline and will further develop basic engineering research and scholarship. It is proposed in response to the needs and requests of local industry, and as a community service to the region, state, and nation. Our industry collaborators have expressed the need for a Doctoral program focused in Computer related research, and have expressed considerable enthusiasm about this proposal as evidenced by the attached letters of support.

Nationally, a dedicated Ph.D. program in the Computer Science and Engineering department will significantly improve our visibility. With Computer Science and Engineering research conducted under the umbrella of Systems Engineering, we are absent from most (if not all) databases, and invisible to almost all search engines where students look for a Ph.D. in Computer Science. Notably, we are absent from the databases maintained by the professional computer science associations (Association of Computing Machinery, Institute for Electrical and Electronics Engineering Computer Society, Association of Computing Research). These are the major conduits utilized by students while searching for programs to pursue doctoral degrees.

By listing in national databases, our program can be ranked in and listed in directories such as the <http://survey.nagps.org>, which surveys the national doctoral programs offering a Ph.D. in Computer Sciences. Attracting quality students is a key to our success. By offering doctoral degrees in Computer Science and Informatics with specialization areas in Software and Information Technology, we would be able to compete nationally and internationally for attracting students from a pool of

students interested in research in the field of computers and information technology.

Therefore, unless we are visible as a Ph.D. program in Computer Science and Informatics it is going to be very hard to attract good students who are committed to become the leading researchers of these fields.

## 1.4 Structure of the Program

The proposed Ph.D. program is in line with the undergraduate and Masters programs offered by the Department and reflects the research interests of the department's faculty. The Computer Science and Engineering Ph.D. program has the following two concentrations or streams:

- (a) *Computer Science Stream*: For students interested in research in computer science. This stream is a natural continuation for students with a Master in CSE or Software Engineering. The student's expected research focus for this stream will be in the theoretical aspects of computer science and/or software engineering.
- (b) *Software and Information Technology Stream*: This stream is designed for students interested in the application of Software and Information Systems to multi-disciplinary problems, encompassing systems biology and bioinformatics, financial and project information management, nursing, library sciences, geographical information systems, etc. This stream is a natural continuation for students with Masters degrees in Software Engineering and Information Technology (SEIT). The focus of student research in this concentration is expected

to be the applied aspects of computing.

## 1.5 Goals of the Programs

A Ph.D. program will provide the means for junior faculty to build their professional career and will be necessary to for all the faculty to sustain their research in the frontiers of computing. Furthermore, the program will attract qualified students locally as well as nationally and internationally. It is designed to prepare these students for academic positions as well as for careers in industrial or governmental research and development laboratories.

Overall, the goals of the program are:

- (a) To sustain existing research and increase the overall research productivity level in the department,
- (b) To attract qualified students to Oakland University and prepare them for research careers,
- (c) To improve the funding base of the CSE department,
- (d) To further enhance the excellence of our graduate course offerings,
- (e) To stimulate additional interaction with local industries, and
- (f) To provide a competitive edge for our doctoral graduates in seeking jobs with focus on computing research.

These goals are consistent with many of the goals expressed in the university's vision and the report of the Strategic Planning Task Force (April 2003) outlining the goals of the School of Engineering and Computer Science, Oakland University. The Task Force's report recommended that B.S. programs be introduced in Engineering Biochemistry, Engineering Management, and Information Systems. Consistent with those goals at the graduate level are our new M.S. program in Software Engineering and Information Technology (SEIT). The Software Engineering and Information Technology concentration of the proposed Ph.D. program is the next phase in the implementation of this strategic plan and provides our doctoral students with the ability to excel in multi-disciplinary computing research.

This program contributes to our focusing resources on creating and strengthening areas of graduate study in a manner that is responsive to regional and national needs. Oakland University's goals pertaining to **creating the future** will be met by our focus on research, scholarship and creative activities that are the university's greatest strengths today. These will be strongly encouraged and supported along with the university's mission and views on community outreach as an integral component of our activities. A **focused doctoral program** with stronger emphasis on Computer Science and Informatics will provide us with expanded opportunities to serve our constituents and contribute to the economic growth of our community.

## 1.6 Source of Students

There is a large pool of college graduates in the southeastern Michigan area. Many of these graduates are currently employed by the local automotive industry and its suppliers. The proposed doctoral degree program will attract these students and allow them to continue their graduate studies locally. Currently we attract some of these students who opt to enroll in our Systems Engineering program and conduct Computer Science research under that umbrella. By offering a dedicated program, we will be much more visible to students nationwide.

As our current doctoral program in Computer Science and Engineering falls under the auspices of Systems Engineering, our program is not listed in major databases of Computer Science doctoral degree granting institutions such as the National Doctoral Program Surveys for Ph.D. in Computer Sciences – <http://survey.nagps.org>. Consequently, prospective students searching for potential computer science and engineering related doctoral institutions do not apply to our programs. The new program will enable us to reach a larger body of prospective students. With a larger pool of applicants, we will be able to screen the applications more rigorously. In this manner, we can enhance the quality of our students as well as increase the enrollment. With the proposed *dedicated* program, we will be more competitive for international students and scholars as well. Furthermore, our faculty will be intimately involved with this process and will recruit students on an individual basis.

Unquestionably, our department will attract students to a Computer Science and Informatics program much more effectively in comparison to the attempts to recruit

students for pursuing Computer Science research under the Systems Engineering umbrella.

## 1.7 Comparison to Other Programs in Michigan

Currently, five state-supported universities in Michigan offer Ph.D. programs in computer science and engineering. These are:

1. The University of Michigan: Ph.D. in Computer Science and Engineering.
2. Michigan State University: Ph.D. in Computer Science.
3. Wayne State University: Ph.D. in Computer Science and Computer Engineering.
4. Western Michigan University: Ph.D. in Computer Science.
5. Michigan Technological University: Ph.D. in Computer Science, and Ph.D. in Computational Science and Engineering.

All five programs share the same goal of training top researchers who will play leading roles in the area of computer science and engineering. The following notable differences characterize our program in comparison to these programs. We believe that these distinctions will help us succeed in attracting quality students to Oakland.

- Our newly proposed multi-disciplinary stream in software and information technology is unique and unparalleled by any other similar program in the State of

Michigan.

- Our programs and research focus of some faculty is “applied” in nature and our research constituents located in the Oakland Technology Corridor and with research support provided by companies like DaimlerChrysler, Delphi, TRW, Fanuc, Parke-Davis, etc. Our programs thus fulfill the unique needs of these constituents and provides our prospective doctoral students with an opportunity to work on applied computing research.
- From the standpoint of theoretical computer science and multidisciplinary research, our faculty has nationally acclaimed expertise in the areas of network security, bioinformatics, static program analysis and logic programming. These specialization areas are complementary to the expertise of faculty at other Michigan universities.

Furthermore, our program will be unique as we expect that the majority of the Ph.D. students in our program will be employed in industries in Northern Oakland County. Additionally, our students in the Software and Information Technology concentration are expected to pursue doctoral studies in multi-disciplinary areas and will be co-supervised by the faculty in Business School, Education, Nursing, Biological Sciences, Chemistry, etc. Therefore, it is anticipated that there will be little or no conflict with the other five universities in terms of competition for students.

## 2 Current Status

### 2.1 Relationship to Systems Engineering

At the present time, the department of Computer Science and Engineering graduates between 2–3 doctoral students per year. These students take courses in Computer Science and Engineering and conduct pioneering research related to the fields of computing and information technology. They are supervised by the our departmental faculty with specialization in core computing areas. However, the degree that they are awarded is in the field of *Systems Engineering*.

The Systems Engineering program was started at Oakland over 30 years ago. As the field of engineering specialized, other departments, namely Computer Science and Engineering, Mechanical Engineering, and Electrical and Systems Engineering were added and provided training for doctoral level researchers under the umbrella of Systems Engineering. This model has become somewhat obsolete, and in 2001 the department of Mechanical Engineering began awarding its graduating doctoral students a degree in Mechanical Engineering.

Our proposal aims to continue this restructuring process. Our faculty believes that the degree awarded must correctly reflect the training and expertise of our graduating doctoral students. Therefore, we propose to offer a doctoral degree in *Computer Science and Informatics*. In this manner, we correctly represent the training of our graduating doctoral researcher.

## 2.2 Goals of the Unit Served by the Program

The proposed program is part of an ongoing effort by the CSE department to stay at the forefront of the rapidly evolving computing field in order to serve its students, the community, and the nation. This new program allows the CSE department to better serve students by providing them with a variety of quality programs that are at the same time technically rigorous and highly relevant to the national need in terms of workforce training. The new program will benefit the school of engineering and the university by helping attract more qualified students and by promoting cross-disciplinary teaching and research. Recent publications and recommendations by Computing Research Association, Association of Computing Machinery, and the National Science Foundation were extensively used in creating this new program ensuring that it provides the CSE department with a competitive edge.

## 2.3 Faculty Qualifications and Departmental Strengths

The department's faculty is actively engaged in research in core Computer Science, Software Engineering and Information Technology areas. Many of the faculty have an actively funded research programs. Some of the departmental strengths as demonstrated by publications and research funding are highlighted below:

- Research in *Embedded Systems and Hardware Modeling*: Professors Ganesan, Debnath and Hanna.

- Research in *Multimedia, Databases, Information Retrieval and Knowledge Management*: Professors Sethi, Mili and Singh.
- Research in *Computer Communications and Information Assurance*: Professors Mili and Fu.
- Research in *Theoretical Computer Science and Software Engineering*: Professors Laski, Mili, Lu and Kim.
- Research in *Intelligent Systems*: Professors Sethi and Singh.
- Research in several *Multi-disciplinary* areas is directed by Professor Singh (Bioinformatics), and Professor Hanna (Nano technology).

Faculty in the department are active in writing proposals to the government as well as industrial funding agencies. Long term faculty research awards have been received from the National Science Foundation (NSF), National Institute of Health (NIH), Michigan Space Grants Commission, US Army Tank Automotive Command (TACOM), Michigan Life Science Corridor, DaimlerChrysler, Hitachi, Phillips, EDS, TRW, and Continental Teves, etc.

Our faculty members are also active in professional societies and services in various roles. In the last few years international conferences, such as *IEEE Conference on Electro-Information Technology*, and the *ASEE NCS Conference* were organized by our faculty. Additionally, sessions are regularly chaired at national conferences such as sensor network track the FLARES conference by the AAAI (American Association for Artificial Intelligence).

The CSE department faculty is active in scholarly service with representation in IEEE CAB board, IEEE Southeast Michigan Section, and research journals including *IEEE Multimedia*, *IEEE Transactions on Multimedia*, *Pattern Recognition*, *Pattern Recognition Letters*, *Machine Vision and Applications*.

Overall, the departmental faculty cover a wide spectrum of disciplines and experiences and is frequently called upon to serve on program committees for conferences and invited to make presentations in their research areas for national as well as international conferences and workshops. Faculty is active in research and publishes actively with an average of 20–30 publications per year. The faculty is committed to providing an enriching experience for our doctoral students.

## **2.4 Library Holdings**

The existing holdings of the Kresge library have been adequate for supporting our existing program. However, we recognize that growth in research areas must be met by a corresponding growth of research infrastructure to sustain productivity. Kresge Library currently subscribes to the ACM electronic publications. A small section of IEEE Computer Society publications are also electronically accessible by our students. Additionally, the library has subscription to a set of electronics journals published by Elsevier Press.

The students in the new Ph.D. programs will extensively use these resources. We will expand on this list continually. Generally our goal is to provide the following publications for use by the doctoral students.

- All ACM journals and conferences
- All IEEE Computer Society Journals and conferences
- All Springer Lecture notes in computer science journals

Specifically, the doctoral planning committee has compiled the following list of journals that must be accessible to our students.

NOTE: THE JOURNAL TITLES LISTED IN **boldface** ARE *currently not available in Kresge Library*.

1. Journal of ACM
2. ACM Transactions on Programming Languages and Systems
3. ACM Transactions on Internet Technology
4. ACM Transactions on Information System Security
5. ACM Computer Communication Review
6. **ACM Mobile Networks and Applications**
7. **ACM Wireless Networks**
8. ACM SIGPLAN Notices
9. Theory and Practice of Logic Programming (Cambridge University Press)
10. **Science of Computer Programming**
11. **Journal of Logic Programming (Elsevier)**
12. The Journal of Functional Programming (Cambridge University Press)
13. **The Journal of Functional and Logic Programming (MIT Press)**
14. The Journal of Symbolic Computation
15. Theoretical Computer Science (Elsevier)
16. **LNCS Transactions on Aspect Oriented Software Development**
17. **Lecture Notes in Computer Science**
18. **International Journal of Constraint Programming**

19. **Journal of Visual Languages and Computing**
20. **Journal of Software Maintenance–Research and Practice**
21. Advances in Engineering Software
22. Software – Practice & Experience
23. **Journal of Visualization and Computer Animation**
24. Computer Journal
25. **Journal of Object-Oriented Programming**
26. **Information and Software Technology**
27. Journal of Systems and Software
28. **Computer Languages**
29. **Software – Concepts and Tools**
30. Software Quality Journal
31. IEEE Transactions on Computers
32. IEEE Transactions on Dependable and Secure Computing
33. IEEE Transactions on Software Engineering
34. IEEE Software
35. IEEE Computer
36. **IEEE Trans. on Computer Graphics and Applications**
37. IEEE Trans. on Medical Imaging
38. IEEE Trans. on Intelligent Transportation Systems
39. IEEE Trans. on Communications
40. IEEE Trans. on Information Theory
41. IEEE Trans. on Signal Processing
42. IEEE Trans. on Image Processing
43. IEEE/ACM Transactions on Networking

44. IEEE Journal on Selected Areas in Communications
45. IEEE Security and Privacy
46. IEEE Network
47. IEEE Wireless Communications
48. IEEE Transactions on Wireless Communications
49. IEEE Transactions on Mobile Computing
50. **IEEE/ACM Transactions on Computational Biology and Bioinformatics**
51. **Journal of Bioinformatics and Computational Biology (JBCB), World Scientific**
52. Bioinformatics Journal, Oxford
53. **Journal of Molecular Biology, Elsevier**

The doctoral committee believes that additional journal (and electronics subscriptions) may be added to supplement the ability of students to find related research. These could particularly include expanding the set of IEEE Computer Society subscriptions as well as including journals in interdisciplinary fields such as bioinformatics and nano-technology. Other journal publishers are less well represented (ACTA series for example). Therefore, active communication with the department and the library committee will be maintained in order to continually update and initiate subscriptions to pertinent journals and publications in these fields.

## **2.5 Laboratories and Equipment**

The computing resources in the department of Computer Science and Engineering include UNIX-based Sun workstations and Windows and Linux-based desktops. These

resources are hosted in research laboratories directed by faculty members of the department, including

- *Intelligent Information Engineering Laboratory* develops tools and techniques to intelligently engineer digital information for business, entertainment and industrial applications. Current research topics include content-based retrieval, multimedia data mining and visualization, tools and methods for multimedia information processing, indexing and understanding.
- *Advanced Software and Information Engineering Laboratory* is engaged in data mining research with a focus on bioinformatics, data driven inductive learning, and knowledge based automated software engineering. Computational architectures based on parallel processing and agent-based computing are often utilized in our research.
- *Distributed Decision Making Laboratory* conducts research focused on the development of algorithms for the autonomous and efficient operation of sensor networks. Current projects include the development of distributed algorithms for self-regulation, self-organization, and self-immunity of sensor networks.
- *Network and Information Security Laboratory* conducts research in the area of network and information security. Current research includes detection and mitigation of cooperative attacks in wireless mobile ad-hoc networks, scalable key distribution schemes for sensor networks, Trustworthy Transportation Ubiquitous Systems (TrusT-US), and intrusion classification.

- *Software Verification Laboratory* conducts research in the area of high reliability and safety critical software. Current research includes dependency analysis of Ada programs, integration of testing and formal verification, fault hypotheses in software testing and debugging.
- *DSP Applications Laboratory* focuses applications of DSP based computer systems. Current projects include fuel rack position controller, software and algorithms for data encryption, electric power steering and engine control, and active noise cancelation in real time.

Faculty and Ph.D. Students also have access to computing resources in the School of Engineering and Computer Science. These include three Sun Ray servers, 2 SUN-based NSF servers and 6 PC-based servers. The operating system currently supported within the school include UNIX, Linux, Windows 2000 and Windows XP. In addition, faculty and Ph.D. Students have access to computing resources provided by Oakland University.

The above computing equipment can meet the initial need of the proposed Ph.D. programs. As the program grows, more resources are required for developing new specialized laboratories and research projects.

## **2.6 Impact on the Current Programs**

The proposed doctoral program is a natural progression of the existing programs in our department and will impact them in a synergistic manner. It enables our break-

away from the existing Systems Engineering mold and lets our students focus on important theoretical fields like Information Security, Nano-technology, Bioinformatics, Multimedia, etc. during their advanced doctoral research.

There will a **strong positive impact on the undergraduate** programs as the results of doctoral research often influence the undergraduate teaching and laboratory set-ups. An environment rich in seminars and presentations related to doctoral research will help bring about a broader educational experience for our undergraduates and make them generally more aware of contemporary issues related to computer science and engineering.

The focus of the Software Engineering and Information Technology stream is expected to be multi-disciplinary in nature. This will further provide a fertile ground for interaction of our faculty with their colleagues in other disciplines such as Business Administration, Biology, Chemistry, Nursing, Geography, Mathematics, etc.

The proposed doctoral program will enable our students to work on innovative projects and positively impact the pedagogy at the Master's and Bachelor's level. Research in leading areas of information technology with a focus on the early stages of innovative information technology integration into multi-disciplinary systems will likely be undertaken in conjunction with the local industry or sister departments at Oakland. These activities will have a strong positive influence on the technological advancements and innovations.

Currently, the average number of students graduating with a Ph.D. in Systems Engineering with a major in Computer Science and Engineering varies between 2–3 per

year. It is expected that our new doctoral program will draw more students to choose Oakland University as the forum for pursuing their doctoral degree in Computer Science and Informatics. We anticipate that after the first three years of initiating this program, the number of Ph.D. students graduating our program will increase to 5–7 students per year.

### 3 Doctoral Program Plan

The Doctoral program in Computer Science and Informatics at Oakland University admits students both for part-time and full-time study. The entire program must be completed in seven (7) calendar years regardless of whether the student is full-time, part-time or is full-time for only a portion of their program.

Detailed degree requirements are discussed in Section 3.3. A student entering the program after completing a Master's degree (and all the foundation coursework described in Section 3.3.1) will need to complete the following:

- *Research Seminar* – 2 credit hours
- *Research Initiation* – 2 credit hours
- *Math Course:* Choose from list provided in Section 3.3.2 – 4 credit hours
- *Electives:* Graduate courses – 16 credit hours
- *Dissertation Research* – 24 credit hours

### 3.1 Admission Requirements

The Ph.D. program is designed for students with academic backgrounds in Computer Science, Software Engineering, Computer Engineering, and Information Technology.

Applicants are eligible to apply after a Bachelor's or a Master's degrees in these disciplines. Applicants with academic degrees in related disciplines such as mathematics and electronic engineering may be admitted to the program, but are required to build up basic Computer Science, Software Engineering and Information Systems knowledge through supplemental course work.

Admission is highly selective; applicants need to present transcripts of all previous academic work and submit three letters of recommendation from those who can evaluate their scholarly achievement and potential. The letters must be provided in the standard format specified by the graduate school. Applicants are also required to submit a statement of research objectives and goals. All applicants must submit scores from the Graduate Record Examination (general). The program is designed for students with academic backgrounds in Computer Science, Software Engineering, Computer Engineering, and Information Technology. Applicants are eligible to apply after a Bachelor's or a Master's degrees in these disciplines. Applicants with academic degrees in related disciplines such as mathematics and electronic engineering may be admitted to the program, but are required to build up basic Computer Science, Software Engineering and Information Systems knowledge through supplemental course work.

The following section provides a detailed description of course-work and qualifying

examination requirements for the proposed program.

## 3.2 Degree Requirements

The requirements for the Ph.D. in the Computer Science, Computer Engineering and Software & Information Systems are identical. Upon admission to the Ph.D. program in the Computer Science and Engineering, the students gain the status of Ph.D. applicant. Their status changes to a Ph.D. candidate after they have successfully passed their Qualifying examinations.

Within the first two regular semesters<sup>1</sup> of becoming a Ph.D. applicant, the student must choose one of the following two specialization streams as well as form their Advisory Committee.

- Computer Science
- Software and Information Technology

Students are advised to form a doctoral committee as early as possible. The advisory committee must be in place before the the applicants are allowed to appear for the qualifying examinations required of their chosen stream. The committee will be comprised of three advisors, and a member appointment by the Dean of the School of Engineering and Computer Science.

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<sup>1</sup>A regular semester is defined to be the Fall or Winter semester.

Program requirements for obtaining a doctoral degree within the Department of Computer Science and Engineering are as follows:

For students holding a M.S. degree: A minimum of 48 credit hours of graduate courses is required for the degree, including the 24 credit hours of dissertation research.

For students holding a Bachelor's degree: A minimum of 80 credit hours of graduate courses are required for the degree, including the 24 credit hours of dissertation research.

The following requirements must be satisfied in order to receive the doctoral degree:

- All Ph.D. applicants are required to pass the **Core** qualifying examination within the *first four regular semesters* of admission into the Ph.D. program. The **Core** examination is administered once every regular semester.
- All Ph.D. applicants must pass **any two Option** qualifying examinations pertinent to their stream. The doctoral committee must be appointed before a student may appear for an *Option* examination. The *Option* examinations are administered once every calendar year.
- All Ph.D. applicants must pass an **Oral Examination** where they are questioned on the broad scope and methodology of their research topic.
- The three written and the oral examination must be completed within three years of joining the program. Upon successful completion of the qualifying examinations the student status changes from a *Ph.D. Applicant* to a *Ph.D. Candidate*.

- All Ph.D. applicants are required to complete a 2-credit hour Research Seminar course, and a 2-credit hour Research Initiation course.
- All Ph.D. students are required to complete a 4-credit hour course in Mathematics. A list of approved courses to choose from is provided in Section 3.3.1. An alternate course may be chosen with approval of the doctoral committee.
- All Ph.D. students must demonstrate some experience in teaching. The supervising faculty or departmental chairman and the faculty in-charge for the Research Seminar course will certify to the completion of teaching experience requirement.
- The entire program must be completed within a period of seven calendar years.

### **3.3 Coursework Requirements**

#### **3.3.1 Foundation Coursework**

If any of the following foundation courses in Computer Science or Mathematics have not been taken in another program, these must be completed at the earliest opportunity:

- Data Structures,
- Computer Architecture,
- Operating Systems,
- Programming Languages,

- Software Engineering,
- Theory of Computation, and
- Design and Analysis of Algorithms.

### 3.3.2 Advanced Mathematics Course

Additionally, doctoral students will be required to complete **one** of the following courses (the **Math Course** in the program of study):

- APM 533: Numerical Methods
- APM 534: Applied Numerical Methods
- APM 569: Graph Theory and Applications
- STA 521: Multivariate Statistical Methods I
- STA 527: Linear Statistical Models
- STA 530: Time Series
- MTH 651: Functional Analysis

### 3.3.3 Electives

The core foundation courses provides the students with the competency in theoretical principles necessary to specialize in computer science and information technology research. The courses listed in Section 3.3.1 are generally completed during the Senior year in an Bachelor's degree program or a Master's program in Computer Science. In addition, programmatic requirements mandate one advanced Mathematics course from the list provided in Section 3.3.2. Moreover, there are two courses each worth two credit hours each entitled *Research Seminar* and *Research Initiation* that each Doctoral student is required to take. Generally, the student must take the Research

Seminar before taking Research Initiation. The seminar course is designed to let the students conduct literature and pre-emption research for their field of interest, while the initiation course is designed to get them begin work on their chosen field of study.

Assuming that the doctoral student has completed their foundation coursework as a part of their 32-credit hours Master's degree, they will need to complete 24 credit hours of additional coursework to meet the total coursework requirements for the doctoral degree. If the student takes a four (4) credit hours for the Math course and four (4) credit hours of required research courses (Research Seminar + Research Initiation worth two (2) credit hours each), there will typically be 16 credit hours remaining for elective courses.

These electives may be chosen as believed pertinent by the student. Students are strongly advised to consult their advisor and/or the committee in choosing these electives.

## **3.4 Qualifying Examinations**

The applicant must pass the *Core* qualifying examination in Computer Sciences and Informatics. In addition to passing the common *Core* examination, the applicant must pass *any two Option* qualifying examinations pertinent to their stream. Student must have their doctoral committee established before appearing for the *Option* Examinations, and should elect the examination subject areas in consultation with the advisory committee.

### **3.4.1 Core Examination**

The core examination must be completed by all Ph.D. applicants irrespective of the chosen stream of specialization. This examination may be completed before the applicant has formed a doctoral advisory committee.

The core examination will be conducted by the department once every regular semester. The syllabus for the core qualifying examination comprises of:

- Analysis of Algorithms
- Discrete Mathematics
- Data Structures
- Programming Languages
- Computer Architecture
- Operating Systems

### **3.4.2 Option Examinations**

Based on the stream selected by the Ph.D. applicant, two examinations from the appropriate set must be chosen in consultation with the applicant's advisory committee.

- **COMPUTER SCIENCE** (applicants select any two exams)
  1. Formal Methods and Theoretical Computer Science
  2. Software Engineering
  3. Database Management Systems
  4. Computer Networking and Communications
  5. Knowledge Engineering
- **SOFTWARE AND INFORMATION TECHNOLOGY** (applicants select any two exams)
  1. Object Oriented Analysis and Design
  2. Information Storage and Retrieval
  3. Bioinformatics
  4. Software Engineering
  5. Multimedia and Wireless Systems

### **3.4.3 Oral Examination**

Within one semester of successfully completing the written qualifying examination, the Ph.D. applicant will present a brief summary of their proposed research to a committee appointed by the department. This committee may or may not be the advisory committee of the applicant. The purpose of the Oral Qualifying Examination is to evaluate the applicant's knowledge of research techniques, level of skills of becoming a productive researcher, as well as basic awareness of research ethics. The focus is less on the content but more on the specific techniques of conducting research.

## **3.5 Teaching Experience Requirement**

The Department of Computer Science and Engineering at Oakland University considers that relevant teaching experience in computer science and engineering is an integral part of a candidate's research career. Successful computer scientist, even in non-academic careers, are often called upon to make presentations and train their proteges in order to make appropriate advancements in research. Further, they are also called upon to disseminate information on mature technologies and to facilitate technology transfers.

Accordingly, unless waived due to candidate's prior teaching experience, our Ph.D. program requires students to teach a course for one term. This may be accomplished concurrently with the Research Seminar course. By enabling them to serve as instructors, the seminar course is designed to provide them with this experience. The

goal of this teaching requirement is to ensure that all graduates of our Ph.D. program are proven teachers and have experienced the group dynamics of teaching and are comfortable in leading classroom discussions. The students are encouraged to avail the opportunities to direct undergraduate students on problem solving strategies, particularly within the context of senior projects, is encouraged.

### **3.6 Recruitment Plan**

Since the proposed program will be very closely tied to the department, we will be able to better focus on our recruitment efforts by creating a web-presence. We will also begin listing ourselves in the major databases of Computer Science and Engineering related programs that our prospective students consult while planning their doctoral education. Our faculty will also be able to easily recruit students at the individual level, since it is considerably easier to attract students to a Computer Science and Informatics degree than it is to attract them to a Systems Engineering degree.

During the first three years, we have set very realistic and achievable goals. After the first three years of starting this program, we expect to double our doctoral student enrollment and reach a level of granting 5–7 degrees per year, using our existing degree granting rate of 2–3 per year as the basis. Subsequently, we express our growth rate to be around 10-15% per year. More importantly, we will attract higher caliber students and create synergy within our faculty to enable us to achieve national and international recognition further resulting in the recruitment of bright young researchers.

**Ph. D. Program of Study**  
**Computer Science and Informatics**  
**Department of Computer Science and Engineering**  
**School of Engineering and Computer Science, Oakland University, Rochester, MI**

Student Name: \_\_\_\_\_ Student No: G00  
 Term of Admission to Program: \_\_\_\_\_  
 Area of Interest: \_\_\_\_\_ Ph.D Degree: Comp. Sci. / Soft. & Info. Tech. (please circle)

Advisory Committee: Chair \_\_\_\_\_  
 (Date Approved:) Member \_\_\_\_\_  
 Member \_\_\_\_\_  
 Appointed Member \_\_\_\_\_  
 Optional Member \_\_\_\_\_

Ph.D. Coursework (Minimum 56 credits beyond Bachelors Degree)					
Course No.	Course Title	Semester	School	Credits	Grade
1.	Math Course: _____			4	
2.	Research Initiation		Oakland	2	
3.	Research Seminar		Oakland	2	
<b>Foundation Courses (Typically - 32 credits hours of 500+-level courses)</b>					
1.					
2.					
3.					
4.					
5.					
6					
7					
8.					
<b>Electives (Typically - 16 credits hours of 500+-level approved graduate courses)</b>					
1.					
2.					
3.					
4.					
5.					
<b>Additional Courses</b>					
1.					
2.					
3.					
4.					

Table 1: Program of Study. Ph.D. in Computer Science and Informatics..



## 4 Needs and Costs of the program

Our new doctoral program is expected to attract more prospective applicants from our local area, at the national and international levels. Thus our growth rate is projected at graduating 5–7 doctoral students per year by 2010 (compared to the current level of 2–3 students per year). In addition, with the recruitment of high caliber students and scholars our faculty is expected to generate additional revenues through higher success in extramural funding. While this is hard to estimate, it would not be unrealistic to expect funding in the range of approximately \$25,000–\$35,000 per new faculty hired. This is based on the average funding levels of our existing faculty. The extramural funding could be in fact be higher than our current average due to an increase in the success rate attributed to a better quality of research proposals written with the help of higher-caliber doctoral students that we would recruit under our new program.

Presented below is the estimation of the revenue and expenses attributed to the doctoral program. We currently have 25 FTEs that are pursuing doctoral program in the CSE department.

Although the intellectual maturity of the department is sufficient to support our existing pipeline of doctoral students, the additional volume of doctoral students will necessitate that additional faculty be hired. We anticipate hiring one additional faculty in the second year after the approval of the program. Resources are also being requested for additional part-time faculty appointments and teaching assistantship. This will help in alleviating the teaching load of regular faculty to enable them to focus on directing doctoral dissertation research. The following assumptions were

Program Title	Ph.D. in Computer Science and Informatics				
Program Start Date	Fall 2007				
		Year 1 (FY 2007)	Year 2 (FY 2008)	Year 3 (FY 2009)	Year 4 (FY 2010)
<b>Headcount</b>		25	30	35	40
<b>Credit Hours Per Student</b>		16	16	16	16
Undergraduate		0	0	0	0
Graduate		0	0	0	0
Total Credit Hours (Doctoral)		400	480	560	640
Doctoral FYES		25	30	35	40
<b>Total FYES</b>		25	30	35	40
<b>Tuition Rate Per Credit Hour</b>					
Undergraduate		\$ -	\$ -	\$ -	\$ -
Graduate		\$ 293.00	\$ 302.00	\$ 311.00	\$ 320.00
Enrollment Fees per Semester		\$ 243.00	\$ 243.00	\$ 243.00	\$ 243.00
Other Fees		\$ 13.00	\$ 13.00	\$ 13.00	\$ 13.00
<b>Revenue</b>					
Tuition		\$ 117,200.00	\$ 144,960.00	\$ 174,160.00	\$ 204,800.00
Enrollment Fees		\$ 12,150.00	\$ 14,580.00	\$ 17,010.00	\$ 19,440.00
Course Fees		\$ 5,200.00	\$ 6,240.00	\$ 7,280.00	\$ 8,320.00
Other Fees		\$ -	\$ -	\$ -	\$ -
<b>Total Revenue</b>		<b>\$ 134,550.00</b>	<b>\$ 165,780.00</b>	<b>\$ 198,450.00</b>	<b>\$ 232,560.00</b>
<b>Expenses</b>	<b>ACCT</b>				
<b>Salaries/Wages</b>					
Faculty Salaries	6101	\$ -	\$ 80,000.00	\$ 82,400.00	\$ 84,872.00
Visiting Faculty	6101	\$ -	\$ -	\$ -	\$ -
Administrative	6201	\$ -	\$ -	\$ -	\$ -
Clerical	6211	\$ -	\$ -	\$ -	\$ -
Administrative - IC	6221	\$ -	\$ -	\$ -	\$ -
Faculty Inload (Replacement Costs)	6301	\$ -	\$ -	\$ -	\$ -
Faculty Overload	6301	\$ -	\$ -	\$ -	\$ -
Part-time Faculty	6301	\$ 4,000.00	\$ 4,000.00	\$ 8,000.00	\$ 8,000.00
Graduate Assistant	6311	\$ 12,000.00	\$ 12,000.00	\$ 24,000.00	\$ 24,000.00
Wages	6401	\$ -	\$ -	\$ -	\$ -
Out of Classification	6401	\$ -	\$ -	\$ -	\$ -
Overtime	6401	\$ -	\$ -	\$ -	\$ -
Student	6501	\$ -	\$ -	\$ -	\$ -
<b>Total Salary Expenses</b>		<b>\$ 16,000.00</b>	<b>\$ 96,000.00</b>	<b>\$ 114,400.00</b>	<b>\$ 116,872.00</b>
Fringe Benefits	6701	\$ 346.00	\$ 32,650.00	\$ 33,965.12	\$ 34,963.31
<b>Total Salary and Fringe Benefits</b>		<b>\$ 16,346.00</b>	<b>\$ 128,650.00</b>	<b>\$ 148,365.12</b>	<b>\$ 151,835.31</b>
<b>Operating Expenses</b>					
Supplies and Services	7101	\$ 2,500.00	\$ 2,500.00	\$ 2,500.00	\$ 2,500.00
Graduate Assistant Tuition	7101	\$ 5,382.00	\$ 11,087.00	\$ 11,420.00	\$ 11,763.00
Facility Charges	7101	\$ -	\$ -	\$ -	\$ -
Travel	7201	\$ -	\$ -	\$ -	\$ -
Telephone	7301	\$ -	\$ -	\$ -	\$ -
Equipment	7501	\$ -	\$ -	\$ -	\$ -
Library	7401	\$ 25,000.00	\$ 27,500.00	\$ 30,000.00	\$ 35,000.00
<b>Total Operating Expenses</b>		<b>\$ 32,882.00</b>	<b>\$ 41,087.00</b>	<b>\$ 43,920.00</b>	<b>\$ 49,263.00</b>
<b>Total Expenses</b>		<b>\$ 49,228.00</b>	<b>\$ 169,737.00</b>	<b>\$ 192,285.12</b>	<b>\$ 201,098.31</b>
<b>Net Income/Loss</b>		<b>\$ 85,322.00</b>	<b>\$ (3,957.00)</b>	<b>\$ 6,164.88</b>	<b>\$ 31,461.69</b>
Percentage of Expenses to Tuition		42.00%	117.09%	110.41%	98.19%
<b>Anticipated Increase in External Funding</b>		<b>\$0</b>	<b>\$25,000</b>	<b>\$30,000</b>	<b>\$40,000</b>
<b>Anticipated Net Income/Loss</b>		<b>\$ 85,322.00</b>	<b>\$ 21,043.00</b>	<b>\$ 36,164.88</b>	<b>\$ 71,461.69</b>

Table 3: **Proforma.** An estimation of the revenues and expenses associated with the new Ph.D. program in Computer Science and Informatics. The program will be expected to generate revenues through the increased student enrollment and is anticipated to be profitable from inception through expected increase in extramural funding.

made in developing the Proforma shown in Table 3.

- **Tuition Revenue Increase:** Over \$100,000 by Year 4

Starting with our current enrollment of 25 students, we expect to grow at the rate of admitting five additional students per year over the next four years. In steady state we will have 40 FTE doctoral students in the program. The new doctoral program is expected to lead to an increase in our enrollment. Our estimates, based on the success of the Mechanical Engineering's doctoral program, project an increase in the enrollment to be at the rate of 5 additional students enrolling per year over the next four years when the program enrollment reaches our desired steady state of 40. This is approximately a 50-60% increase over our existing enrollment of 25 doctoral students. This will result in an increase of our tuition revenue by \$100,000 in Year 4.

- **Expenses - Personnel:**

- (i) One faculty line is being requested to support the program. The first position is expected to be filled in year 2.
- (ii) Two part time faculty positions will be created to offset the teaching load of the full time faculty to enable them to focus on directing research and developing external grant proposals. The two part-time faculty positions will be filled in years 1 and 3. The steady state cost of the part-time faculty lines will be \$8,000 per year.
- (iii) Funds are requested for one (1) Graduate Assistant (GA) in Year 1 and an additional Graduate Assistant in Year 3. In the steady state, two GA

will be utilized to support the program's administration. The steady state amount requested is \$39,763 which includes cost of tuition.

- **Expenses - Infrastructure:** \$40,000 per year

- (i) \$2,500 per year for Supplies & Services. This includes the expenses incurred for program advertising and participating in national registries that prospective graduate students use for selecting doctoral programs.
- (ii) And an additional \$25,000 per year is allocated for augmenting the current library holdings to support our new doctoral program. This amount will be increased as the program grows.

Thus, in a steady state the doctoral program will generate a profit of \$30,000 per year. If the anticipated increase in extramural funding is taken into consideration, the doctoral program would generate a profit of \$70,000 to \$100,000 per year in steady state.

## 5 Course Description

Our department currently offers a wide range of courses for doctoral students. These course offerings are constantly being updated by the department's graduate affairs and curriculum committee in light of the needs of our doctoral students. The graduate committee has revised offerings of graduate courses with a series of advanced (and seminar) courses.

The following two courses are being proposed to specifically train our Ph.D. students in methodologies for conducting research as well as for understanding and appreciating the ethical conduct and legal implications of research and innovation.

CSE 7xx : This two credit hour course introduces new doctoral students to research process. The topics covered include: research strategy and tactics, publication and review processes, presentation of research work, intellectual property and ethics.

CSE 7xx **Research Seminar:** This two credit hour course gives doctoral students opportunities to familiarize themselves with research activities in their fields. The students will attend seminars given by researchers from Oakland and other institutions, as well as be required to give seminars about their work and get feedback from peer researchers.

The department offers the following graduate level courses from which the doctoral students will be able to complete their coursework requirements. The qualifying examinations will be modeled after a subset of these courses as well. This list of courses have been compiled by the CSE graduate committee and reflects the needs of our students and the goals of our graduate programs. A review of the courses is conducted by the committee on a regular basis so as to keep this list current and competitively organized.

CSE 5X1 **Software Prototyping and Validation:** This is a project-oriented course geared towards the creation of a validated, interpretable and thoroughly tested model of software for which, in most cases, C++ code can be automatically generated. It builds on the VDM-SL notation covered in CSE 520 and is supported by the VDM-SL Toolbox.. TOPICS: Program development cycle. Principles of step-wise, correctness preserving refinement. Requirements synthesis; Direct and indirect models; Operation refinement for structured programming constructs. Data refinement: Abstract Data Types (ADT) in program development, user-defined types, representation of ADT. Model validation: testing and proof obligations; automated random testing of the final model using an executable postcondition of the problem as a test oracle.

- CSE 513 **Computational Intelligence:** This course covers fundamental notions of modern artificial intelligence and fuzzy logic. Topics include: problem solving (informed search methods); knowledge and reasoning (inference in first-order logic); planning/acting; reasoning under uncertainty (probabilistic reasoning systems, decisions making) and fuzzy inferences (Mamdani, Sugeno, and Tsukamoto); parameter identification and learning from observations (neural and belief networks, Genetic algorithms). The course will also discuss recent applications of artificial intelligence (such as Chess, Othello, robot navigation), and fuzzy logic (fuzzy controllers). Prerequisites APM 263.
- CSE 520 **Fundamentals of Software Modeling:** Laboratory Oriented course on mathematical modeling of Software Engineering Issues. Program Specifications: Direct and indirect specifications, assertions; mathematical concepts involved: Propositions, Predicate calculus. Abstraction Notations: Sets and set operations, sequences, maps, bags, lambda notation. Algorithm Definition: Functions, operations, polymorphic functions, higher order functions. Stepwise Program Refinement: Programming by contract, correctness maintaining transformations; Static Analysis of Computer Programs: Relations, Flowgraphs, Data and Control Dependencies, Detection of Anomalies. Modeling Software Design: Procedure Call Graph, modules export/import relations. Modeling Program Execution: Computation trace, dynamic data and control dependencies.
- CSE 522 **Object Oriented Analysis and Design:** This course covers the methodologies of object oriented (OO) modeling during the planning, analysis and design stages of software systems development. Predominant methodologies and techniques such as the Unified Modeling Language (UML) will be surveyed. OO programming using an OO language such as C++ or Java is not covered in this course. Topics include both process oriented issues, such as the application of use case modeling during OO requirements analysis, and product-oriented issues, such as the definition of an OO design using class diagrams. *Prerequisites: CSE 231 and CSE 434.*
- CSE 535 **Programming Languages and Compilers:** Modern topics in programming languages such as: aspect-oriented programming, constraint programming, logic programming, formal syntax and operational semantics. Aspects of language compilation such as: lexical analysis, syntactic analysis and translation. Prerequisite: CSE 335 and CSE 343
- CSE 538 **Software Verification and Testing:** The course consists of three main parts: Formal Verification (proofs of correctness), Static Program Analysis (detection of program anomalies, explanatory analysis, static debugging) and Dynamic Program Analysis (testing and debugging), the latter two representing software engineering approach to software verification. Most of the course consists of lectures by the instructor and discussions of the assignments. If the size of the

class is relatively small, a seminar could be required in lieu of an assignment. Two software tools are used: SPARK (Static Analysis , Verification), and STAD, System for Testing And Debugging, for static analysis and testing.

- CSE 539 **Software Engineering:** An overview of software development processes, tools and techniques from the perspective of learning what they can and cannot do; deciding when, how and why to apply them; and selecting among the available alternatives. Requirements analysis and specification techniques; life-cycle models; process modeling; software design methods; project planning and management; quality assurance; configuration management; program and system testing. *Prerequisite: CSE 231.*
- CSE 541 **Software Project Planning, Management and Maintenance:** Software project planning and management topics include uncertainty and risk analysis; planning a software project; project modeling, scheduling and milestones; resource allocation; software cost estimation; mechanisms for monitoring and controlling schedule, budget, quality and productivity; staffing, leadership, motivation, and team building; communication management and project documentation. *Prerequisite: CSE 539 or equivalent.*
- CSE 542 **Software Architecture and Components:** Methodologies for rapid prototyping and component software use. Topics include: platforms for rapid prototyping and object-oriented software development; available software components; object request brokers (COM/CORBA/OLE); data modeling, transaction processing and federated databases; client and server web technologies. A theory and project oriented course. *Prerequisite: CSE 231.*
- CSE 545 **Database Systems:** Continuation of CSE 445. Concurrency control, recovery, and query optimization for database systems; distributed database systems; object-oriented database systems; knowledge-base systems; optimization of conjunctive queries and linear recursions; experimental knowledge-base systems; the universal relation as a user interface. Students will create and conduct studies of standard relational databases as a laboratory component of this course. *Prerequisite: CSE 445 or equivalent.*
- CSE 549 **Wireless and Industrial Networks:** Wireless networking topics covered include wireless computer network protocols (802.11, WiMax), wireless personal area network protocols (Bluetooth, ZigBee), wireless sensor networks and cellular networks. Industrial and embedded networking topics covered include Controller Area Network (CAN), Modbus, Profibus, Foundation Fieldbus and Industrial Ethernet. Networking applications are designed and implemented as student projects. *Prerequisite: CSE447 or equivalent.*

- CSE 550 **Operating Systems:** Introduction to the concepts and design of multi-programmed operating systems. Typical topics include: historical perspectives; sequential processes; concurrent processes; processor management; store management; scheduling; file management; resource protection; a case study. *Prerequisites: CSE 506 & CSE 508.*
- CSE 551 **Advanced Web Design and Applications:** Advanced concepts in WEB design including protocols for integrating databases and effective information exchange necessary for developing enterprise resource management systems are covered. Evolving technologies and web application development architectures, including multi-tier processing, session management, security, and availability are discussed. The students complete a web application as a part of the course. *Pre-requisites: CSE251, CSE445 or equivalent.*
- CSE 555 **Visual Computing:** Visual computing is the confluence of computer vision, image processing and analysis, computer graphics, and visual information management. This course covers fundamentals of visual computing with emphasis on image processing, image analysis and graphics rendering. The topics to be covered include: image filtering, image compression, image segmentation, image morphing, 2D/3D primitives, 2D/3D geometry transformation, 2D/3D rasterization, illumination and animation. *Prerequisite: Linear algebra*
- CSE 561 **Advanced Data Structures and Algorithms:** A course systematically studies advanced data structures, and the design and analysis of algorithms. The main focuses are the techniques for designing algorithms using appropriate data structures, proving correctness, and analyzing the computational complexity of algorithms. Topics covered include: hash tables; data structures for combinatorial optimization; search trees; recurrence relations; divide and conquer; dynamic programming; greedy methods; advanced graph algorithms; linear programming. This course will be supplemented by algorithms selected from the recent technical literature. *Prerequisite: CSE 361*
- CSE 564 **Computer Architecture:** The course explores current trends and future directions in processor micro-architecture as well as various hardware and software techniques in high-performance computing. A review of pipeline and memory hierarchies is followed by advanced topics including branch prediction, dynamic scheduling, superscalar techniques, speculative execution, prefetching, high-speed I/O, VLIW, multi-threaded processors, and application-specific processors such as those for embedded and multimedia systems. *Prerequisite: CSE 364 or equivalent.*
- CSE 565 **Micro- and Nano-Embedded Systems:** This course will focus on introducing micro-scale embedded systems. This includes digital, analog, mixed-mode,

and micro-electromechanical systems (MEMS). An introduction to basic fabrication techniques for analog and micro-electromechanical systems will be given. The course will focus on applications that have been developed and are currently under development using mixed-mode embedded systems and MEMS, particularly for automotive, consumer products, sensors, and biomedical applications. An introduction to technology of nano-scale will be given. *Prerequisite: equivalent of a course in digital and analog electronics.*

**CSE 570 Real Time Microprocessor Software and Systems:** Application of microprocessors and microcomputers to the solution of typical problems; interfacing microprocessors with external systems such as sensors, displays and keyboards; programming considerations, microcomputer system and memory system design. A laboratory design course; several short design projects and one large design project. This course integrates concepts learned in required courses and provides a design experience. The large design project includes cost trade-off analysis, submitting a detailed written report and oral presentation of the project. *Prerequisite: programming in a high-level language.*

**CSE 578 Embedded Systems Design Using FPGAs:** The use of hardware description languages such as VHDL in the design of embedded systems containing both an FPGA and a microprocessor; high-level design tools to specify, simulate and synthesize designs to FPGAs; design examples.

**CSE 581 Information Retrieval & Knowledge Discovery:** This course covers the models for information retrieval from text and multimedia databases. Methodologies for database indexing and visualization are discussed. Statistical and deterministic algorithms for discovering knowledge from databases, including, decision trees, clustering, regression, and neural models are covered. *Prerequisites: CSE445 or equivalent.*

**CSE 591 Bioinformatics** This course covers biological databases and algorithms for information retrieval from biological databases. Stochastic methodologies for modeling and searching biological motifs and patterns for functional inference are discussed. Algorithms for pair-wise and multiple sequence alignment, phylogenetic reconstruction and gene detection are also covered. *Pre-requisites: CSE445 or Equivalent.*

**CSE 616 Pattern Recognition and Machine Learning:** Introduction to recognition and learning; Bayes decision theory; parametric and nonparametric methods including Hidden Markov models; Discriminant functions including support vector machines; Multilayer neural networks; Decision and regression trees for learning; Performance estimation; Unsupervised learning and clustering; Subspace methods; Applications *Prerequisites: MTH 246 and MTS 627*

- CSE 645 **Database Systems II:** This course is designed to serve as a bridge between studying databases and doing research in databases. Each section of this course will have a specified theme of current research interest. Themes covered in the past include Federated databases, Active databases, Transaction processing in advanced applications, and Data on the web. The course is run on a seminar like format. About half of the lectures are presented by the students. Throughout the semester, students gain the necessary background to understand technical and practical issues related to the theme, survey research proposals related to these issues, and possibly formulate a research proposal for master thesis work.
- CSE 647 **Advanced Computer Networks:** Topics covered include TCP/IP fundamentals, performance measurement and evaluation of TCP/IP networks (tcpdump, tcpstat, jplot, NetPIPE), network simulation (NS & OPNET), modeling, TCP/IP performance in emerging networks, congestion control, queue management, traffic management, TCP flavors and implementation. Current research topics are also covered. TCP networks are simulated and analyzed as student projects. *Prerequisite: CSE447 or equivalent.*
- CSE 650 **Advanced Operating Systems:** This course focuses on distributed operating systems. Topics covered include communication protocols for message passing and RPC, synchronization of distributed systems; processes and processors; distributed file systems; distributed shared memory, Grid computing, and security issues. Students will implement projects using distributed systems. *Prerequisite: CSE 550 or equivalent.*
- CSE 655 **Advanced Visual Computing:** Course Description This course is a continuation of CSE555. It introduces advanced topics in visual computing. Selected papers in visual computing are studied. Selected areas include volume graphics and volume rendering, computational geometry, medical imaging, visual recognition, image/video classification and retrieval, human tracking, scientific visualization, 3D image reconstruction. A research project is mandatory in this course. *Prerequisite: CSE 555.*
- CSE 664 **Parallel Computer Architecture:** Parallel computer systems: SIMD, MIMD, Shared memory, NUMA, UMA architectures, multiple bus, interconnection network, distributed memories, message passing structures, hierarchical caches, snooping controller design, directory based cache coherency, performance evaluation of parallel systems, instruction level parallelism, practical small multiprocessor system design issues, large scalable multiprocessor systems, grid computer performance, chip multiprocessor system (multiple cores), network processors and the future of parallel architectures.
- CSE 665 **Design Automation of Embedded Systems:** The course presents computer-aided design and optimization techniques for embedded systems. The course

focuses on architectural synthesis, minimization of combinational and sequential circuits, optimization for FPGAs, technology mapping, asynchronous synthesis, delay and power minimization, testability, design automation issues in hardware/software co-design, and emerging optimization problems in embedded systems design. In-depth study of a particular topic or software development is required. Prerequisite: Background in digital logic, computer organization, and algorithms.

**CSE 678 Advanced Embedded Systems:** Design of high-speed embedded systems using both a microprocessor and an FPGA. Topics and exercises include designing and implementing an intelligent system using various microcontrollers, profiling and analyzing code for performance, and designing and implementing special-purpose processors on an FPGA to work cooperatively with the microcontroller for significant performance gains. Interface issues between the microcontroller and FPGA-based system and power consumption for mobile systems will also be discussed. Project-oriented course. *Prerequisite: CSE 570 and CSE 578 or experience with a microcontroller and hardware in an FPGA with instructor approval.*

**CSE 681 Information Security:** Introduction to cryptography and its application to networking and operating system security. Topics covered include secret key and public key cryptographic algorithms, hash functions, authentication, digital signature, digital certificate, key management, email security, web security, SSL/TLS, IP security and wireless security, firewalls, intrusion detection and traceback techniques, security threats and countermeasures, and legal and ethical issues. Independent research on network security is required as student projects. *Prerequisite: CSE447 or equivalent.*

## 6 Conclusions

This proposal develops a compelling case for restructuring the existing doctoral degree offered by the department of Computer Science and Engineering. We propose to offer a focused program in Computer Science and Informatics with two concentrations in Computer Science and Software Engineering and Information Technology. We strongly believe that the proposed new program will help us attract high-caliber students and enable them to become more competitive in the marketplace for high-tech research-oriented computing job opportunities. Programmatic details, needs and requirements for evolving the doctoral degree are presented in the proposal.

Being on the cutting edge of technology, the School of Engineering and Computer Sciences must constantly re-invent itself to better serve the needs of its constituents as well as continually position itself on the leading edge to attract bright researchers and scholars to Oakland University. We believe that the proposed program will help us successfully compete with other universities in our area and stimulate research and innovation at Oakland University. The net result will be a rewarding learning experience for our doctoral students resulting in a synergy that helps elevate our success rate in the competition for extramural research funding.

## **7 Plans for Assessment**

The program will be reviewed by the vice provost of Graduate Study and the Graduate Council every five years. Additional evaluations will be obtained from students, alumni, employers, and the departmental advisory board on a regular basis.

## 8 Student Surveys

A departmental student survey was conducted where 246 students responded. About 60% of students responding were undergraduates while the remaining were graduate students.

Your Rank: \_\_\_\_\_ Undergraduate Student      \_\_\_\_\_ Masters Student      \_\_\_\_\_ Doctoral Student

**Student Survey  
Fall 2006**

1. Currently, the Computer Science and Engineering department offers a Ph.D. in *Systems Engineering*. Do you think that the Computer Science and Engineering department should offer a Ph.D. program in *Computer Science and Informatics* instead?  
 Yes                       No                       No Opinion
2. In your opinion, would obtaining a Ph.D. degree enhance your career?  
 Yes                       No                       Maybe
3. Would you be interested choosing a career in *Computer Science and Informatics* education?  
 Yes                       No                       Maybe
4. Would you consider enrolling in a Ph.D. program in *Computer Science and Informatics*?  
 Yes                       No                       Maybe
5. If you are interested in enrolling in a Ph.D. program, would you consider enrolling in a Ph.D. in *Systems Engineering* at Oakland University:  
 Yes                       No                       Maybe                       Not Applicable
6. If you are interested in enrolling in a Ph.D. program, would you consider enrolling in a Ph.D. in *Computer Science and Informatics* at Oakland University:  
 Yes                       No                       Maybe                       Not Applicable
7. If you are presently not interested in pursuing a Ph.D. degree at Oakland University it is because:  
 You do not want to pursue a Ph.D. degree at this time.  
 You do not want to pursue a Ph.D. at Oakland University in any field, but would be interested in pursuing a Ph.D. program at another institution.  
 You do not want to pursue a Ph.D. in Systems Engineering at Oakland, but would be interested in our Ph.D. in Computer Science and Informatics program.
8. Which program do you think will provide you with a better chance of employment:  
 Ph.D. in Systems Engineering  
 Ph.D. in Computer Science and Informatics  
 No opinion
9. Other comments (continue on the other side if necessary):

The student responses on our two target questions, Questions 1 & 8, were quite encouraging.

Question 1. Currently, the Computer Science and Engineering department offers a Ph.D. in Systems Engineering. Do you think that the Computer Science and Engineering department should offer a Ph.D. program in Computer Science and Informatics instead?

**Response**    64%    **Yes**        6%    No        30%    *No Opinion*

It is noteworthy that only 6% students were opposed to the idea of changing the existing Systems Engineering program. The fact that 30% of students did not have an opinion is not very surprising and in fact indicative that the students took the surveys seriously. The niceties of a doctoral program's focus and offerings is difficult for an average BS/MS student to appreciate as they are generally not thinking about pursuing an advanced research focussed degree.

Question 8. Which program do you think will provide you with a better chance of employment:

- Ph.D. in Systems Engineering
- Ph.D. in Computer Science and Informatics
- No opinion

**Response** Ratio of students selecting CSI:SE = 2.85:1. That is, roughly three times as many students thought that they would have a better chance of employment with a degree in Computer Science and Informatics.

## 9 Faculty Vitas

On file with Graduate Education Office. Please see Eilene Lohmeier (lohmeier@oakland.edu) for a review of the faculty vitae.

## 10 Letters of Support



***Vijayan Sugumaran, Ph.D.***

*Associate Professor*

*Department of Decision & Information Sciences*

*School of Business Administration*

*Oakland University*

*Rochester, MI 48309*

*Phone: (248) 370-2831, Fax: (248) 370-4275*

*Email: sugumara@oakland.edu*

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December 7, 2006

Professor Ishwar Sethi  
Chairman  
Department of Computer Science and Engineering  
Oakland University  
Rochester, MI 48309-4478

Dear Professor Sethi:

I am happy to note that the Computer Science and Engineering (CSE) department is considering a new Ph.D. program in Computer Science and Informatics. In today's competitive world, there is always a need for computer scientists and informatics specialists with advanced degree, such as a Ph.D., to develop new technologies and drive innovation. A successful doctoral program encourages students to think outside the box, taking initiatives, identifying potential benefits of new technologies and hence fosters creativity. I certainly believe that the proposed Ph.D. program in Computer Science and Informatics will significantly contribute to the pool of talented and innovative people in the country.

The courses outlined as part of the program are highly specialized yet suitable for advanced students and designed to provide in depth knowledge on the subject matter. The degree requirements are set in high standard. The course credit requirements and qualifying examination passing criteria are in line with other top schools. The overall plan appears excellent for a Ph.D. program.

As a faculty in the Business School doing research in information technology and management, I find the proposed Ph.D. program very appealing because it provides the opportunity to conduct inter disciplinary research. It will also promote interaction between the School of Business Administration and the CSE department. Students in this program will have the potential to explore not only technical issues but also managerial and business issues related to new technologies and innovation. I am very supportive of the proposal and am confident that the university administration will see the optimism and growth potential it encapsulates.

Sincerely,

A handwritten signature in black ink that reads "Vijayan Sugumaran".

Vijayan Sugumaran  
School of Business Administration

November 03, 2006  
Dr. Haizhi Xu  
One Microsoft Way  
Redmond, WA 98052  
U.S.A.

**Microsoft**

Professor Ishwār Sethi  
Chairman  
Department of Computer Science and Engineering  
Oakland University  
Rochester, MI 48309-4478

Dear Dr. Sethi:

I have reviewed the proposal of Department of Computer Science and Engineering at Oakland University for establishing a Ph.D.-granting program in computer science and informatics. The proposed program is both valuable and promising; therefore I strongly support the proposal.

As we all know, the successfulness of undergraduate education is closely tied to the intensity and quality of faculty research. I firmly believe that a Ph.D. program in Computer Science and Informatics will have a prolonged impact on improving the competitiveness of your graduates and the reputation of your department.

The program you proposed will bridge the gap between academic research and industrial applications and should enhance your ability to attract collaborative research partnerships with other academic institutions and the computer industry. The Center for Software Excellence, Microsoft Corporation, where I am working, is involved in program analysis techniques to improve the quality of software products of Microsoft. We are in need of software engineering and information technology talents to join us. Ph.D. holders with specialties of program analysis are very competitive candidates. Your Ph.D. graduates are welcome to apply.

In summary, I strongly support the proposal of establishing a Ph.D. program in computer science and informatics at Oakland University. I hope that the proposal will be well received by the University.

Sincerely,



Haizhi Xu, Ph.D.  
Research Software Development Engineer  
Center for Software Excellence  
Microsoft Corporation

Dr. Uttam Mukhopadhyay  
Deep View Systems, LLC  
380 N. Old Woodward, Ste 150  
Birmingham, MI 48009

Professor Ishwar Sethi  
Chairman, Department of Computer Science and Engineering  
Oakland University  
Rochester, MI 48309-4478

Dear Ishwar:

I would like to support fully the establishment of a Ph.D. program in Computer Science and Informatics at Oakland University. The need is great, the time is right, and the capability is there. The opportunity is wide open for Oakland University to serve the needs of southeast Michigan and globally and enhance the reputation of the University at the same time.

There is a strong demand for computer scientist and information technologists with advanced degrees in this area because of the focus on advanced engineering and research. A successful Ph.D. program at Oakland University will provide local companies with graduates trained with specialized knowledge in widely applicable fields of Computer Science and Informatics.

Sincerely,

Dr. Uttam Mukhopadhyay  
Chairman  
Deep View Systems, LLC

# KELLY

## SERVICES

Keith Ensroth  
Kelly Services, Inc.  
999 West Big Beaver Rd.  
Troy, MI 48084

Professor Ishwar Sethi  
Chairman, Department of Computer Science and Engineering  
Oakland University  
Rochester, MI 48309-4478

Dear Ishwar:

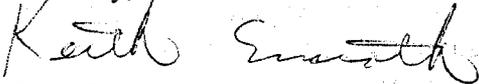
I support fully the establishment of a Ph.D. program in Computer Science and Informatics at Oakland University. As a leader in the IT department of a global 1000 company headquartered in southeast Michigan, I would like to focus on one particular area of need – the role of the enterprise architect.

The options for solving business problems through the use of information technology continue to increase. They include custom-developed software, packaged software, integrated application services provided outside the enterprise and open-source solutions built from components. With this increasing complexity, one of the most critical roles in an enterprise's IT organization is the enterprise architect. While we have a decent supply of intelligent software engineers, the skills needed to grapple with multi-disciplinary questions require a significantly higher degree of rigor. The *Software Engineering and Information Technology Stream* shows great promise for delivering professionals with appropriate training in a the skills needed to deliver enterprise architecture.

The teaching competency required by this program is an important ingredient even if the candidate targets a job in industry, rather than the university. The role of enterprise architect in an IT organization must be collaborative and teaching in order to win the support of the technical staff. Enterprise Architecture programs survive not by fiat, but by the willing participation of all those in the organization who are developing the technical infrastructure of the enterprise.

A successful Ph.D. program at Oakland University will provide local companies with graduates trained in the skill set and approach to be able to meet this growing demand.

Sincerely,



Keith Ensroth  
Vice President of North American Applications  
Kelly Services, Inc.

Intel Americas Inc  
32255 Northwestern Highway  
Suite 212  
Farmington Hills, MI 48334



Paul J. Besl, Ph.D.  
Intel Corporation  
32255 Northwestern Highway  
Suite 212  
Farmington Hills, MI 48334

October 16, 2006

Professor Ishwar Sethi  
Chairman, Department of Computer Science and Engineering  
Oakland University  
Rochester, MI 48309-4478

Dear Ishwar:

I would like to fully support the establishment of a Ph.D. program in Computer Science and Informatics at Oakland University. The opportunity is here now for Oakland University to serve the needs of southeast Michigan and globally enhance the reputation of the University at the same time.

There is a strong demand for computer scientists and information technologists with advanced degrees in this area, especially in the specific area of multi-core computing and the larger area of high-performance computing. A successful new Ph.D. program at Oakland University will help to provide local companies with graduates trained with specialized knowledge in widely applicable fields of Computer Science and Informatics.

Sincerely,

A handwritten signature in black ink that reads "Paul J. Besl". The signature is written in a cursive style and is positioned above a horizontal line.

Paul J. Besl, Ph. D.  
Enterprise Solutions Software Division  
Intel Corporation



Ali Mehidi  
Global Systems Architect  
GM Information Systems & Services  
Renaissance Center, Detroit, MI

Professor Ishwar Sethi  
Chairman  
Department of Computer Science and Engineering  
Oakland University  
Rochester, MI 48309-4478

Dear Dr. Sethi:

I have reviewed the Department of Computer Science and Engineering's proposal for a new Ph.D. program in Computer Science and Informatics. The proposed program is long overdue in my opinion. GM IS&S is involved in many facets of Information Technology and is constantly in need of specialized software engineering and information technology talent.

The program you are proposing will bridge the gap between academic research and industrial applications and should enhance your ability to attract collaborative research partnerships not only with industry but with other academic institutions. As you well know, the quality of undergraduate instruction is closely tied to the intensity and quality of research activities. I therefore believe that a Ph.D. program in Computer Science and Informatics will have an overall positive impact improving the skills of your graduates.

I think it is fairly clear that I support your proposal and I do sincerely hope that it will be received at the University.

Sincerely,

A handwritten signature in black ink, appearing to read "Ali Mehidi", is written over the typed name.

Ali Mehidi  
Global Systems Architect  
GM Information Systems & Services



October 19, 2006

Professor Ishwar Sethi  
Chairman, Department of Computer Science and Engineering  
Oakland University  
Rochester, MI 48309-4478

Dear Professor Sethi:

I am pleased to hear that the Computer Science and Engineering Department at Oakland University is proposing a new Ph.D. program. I have reviewed the executive summary of the proposal and agree that a Ph.D. program in Computer Science and Informatics would help develop the specialized software engineering and information technology talent that is needed in our industry. We look to the university to provide this type of high quality research environment to foster graduates with specialized knowledge in Computer Science.

I am supportive of the proposal and am confident that the university administration will see the potential it encapsulates.

Sincerely,

Susan E. Hobson  
Director of Operations

***Where imagination becomes reality!***

Shaojun Liu  
2845 Olden Oak Lane,  
APT 302  
Auburn Hills, MI 48326

Professor Ishwar Sethi  
Chairman, Department of Computer Science and Engineering  
Oakland University  
Rochester, MI 48309-4478

Dear Professor Sethi:

I would like to lend you my full support for the establishment of a Ph.D. program in Computer Science and Informatics at Oakland University. I have been waiting for this program since I took the Ph.D. program in System Engineering in 2004. The research I am conducting is Computer Science and the courses I have taken are also Computer Science. And I strongly hope that I could receive a Ph.D. degree in Computer Science.

During my previous courses and current research project, I feel that faculties and research facilities in the department of Computer Science and Engineering can fully support a Ph.D. program in Computer Science. The job markets for Computer Science graduates are brighter. And a Ph.D. program in Computer Science will definitely improve the rank of Oakland University in the states. More future students, including students home and abroad will know Oakland University when they check Computer Science rank for U.S. universities. Actually the earlier Oakland University has a Ph.D. program in Computer Science, the better.

If anything I can do to make this Ph.D. program into reality, please let me know.

Sincerely,



Shaojun Liu  
Graduate Research Assistant  
Dept. of Computer Science and Engineering  
Oakland University

Xuan Li  
Microsoft Corporation  
One Microsoft Way  
Redmond, WA 98052  
USA

**Microsoft**

Professor Ishwar Sethi  
Chairman  
Department of Computer Science and Engineering  
Oakland University  
Rochester, MI 48309-4478

Dear Dr. Sethi:

I am pleased to know that Oakland University is considering a new Ph.D. program in Computer Science and Informatics. In today's competitive world, there is always a need for computer scientists and informatics specialists with advanced degree, such as a Ph.D., to develop new technologies and drive innovation. A successful doctoral program encourages students to think out of the box, taking initiatives, identifying potential benefits of new technologies and hence fosters creativity. I certainly believe that Oakland University's proposed Ph.D. program in Computer Science and Informatics will significantly contribute to the pool of talented and innovative people in the country.

The proposed courses are highly specialized yet suitable for advanced students and designed to provide in depth knowledge on the subject matter. The degree requirements are set in high standard. The course credit requirements and qualifying examination passing criteria are in line with other top schools. The overall plan appears excellent for a Ph.D. program.

I am very supportive of the proposal and am confident that the university administration will see the optimism and growth potential it encapsulates.

Sincerely,



Xuan Li  
Software Development Engineer in Test  
Microsoft Corporation



Preston Brooks  
6211 Englewood Drive  
Clarkston, MI 48346  
October 24, 2006

Dr. Ishwar Sethi  
Chairman  
Department of Computer Science and Engineering  
Oakland University  
Rochester, MI 48309-4478

Dear Professor Sethi:

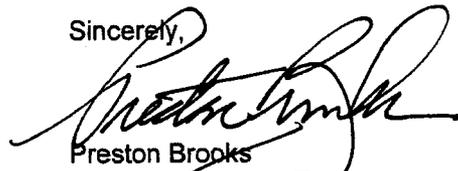
I am very pleased to hear that the Computer Science and Engineering Department at Oakland University is proposing a new Ph.D. program. I am aware of your Ph.D. program in Systems Engineering but the addition of this newly proposed Ph.D. program specifically in Computer Science and Informatics will be a great benefit to the community and industry.

I strongly believe that this new program will promote more industry collaborations and bring better recognition of the fine work that your department and school does. SAIC, Inc. Corporation has always been a strong supporter of Oakland University. SAIC, Inc. currently participates in the CSE Department's "Industry Partners Program" (IPP). In this program, SAIC has agreed to provide a gift to the department's general fund in exchange for regular briefings on departmental ongoing research. Currently, I am participating with Dr. Kim on a joint research project involving the refactoring of legacy software systems.

With the introduction of this new Ph.D. program, I can foresee an increase in our collaborative research projects. I also believe that the new Ph.D. program will further simulate high quality research at Oakland resulting in better education for both the graduate and undergraduate students.

I strongly support this proposal and hope that the University administration would also support the initiation of this new program.

Sincerely,



Preston Brooks  
Software Systems Engineer  
SAIC, Inc.  
35875 Mound Road  
Sterling Heights, MI 48346

Dmitriy Martynov  
55150 Raspberry Drive  
Macomb, MI 48042

Professor Ishwar Sethi  
Chairman  
Department of Computer Science and Engineering  
Oakland University  
Rochester, MI 48309-4478

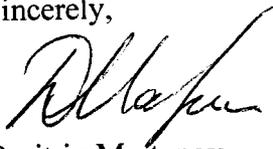
Dear Dr. Sethi:

I am very excited to hear that Oakland University is considering a Ph.D. which will focus on the skills desired in high tech workers in today's competitive marketplace. It is really about time that something like this came along. In fact, my friends, many of whom are OU alumni, and I frequently discuss how we never really use anything we learned in classes, and how acquired most of our skills ourselves. That said, I strongly believe that this new program in Computer Science and Informatics, if properly implemented, will tremendously enhance the educational experience for Oakland University Ph.D. students, and make many more consider it. Moreover, it is almost crucial that more programs like this be offered by the department.

I feel that highly specialized courses are important, because in order for graduates to find employment, they are expected to have a solid skill set and experience with modern technology, in addition to theoretical knowledge. The degree requirements must be set as high as they are, this ensure that the graduating students are of the highest quality. I think the overall plan for this Ph.D. program is excellent.

I am very supportive of the proposal and am confident that the university administration will see the optimism and growth potential it encapsulates.

Sincerely,



Dmitriy Martynov  
System/Network Administrator  
Techni-Serve Inc