

**Doctor of Philosophy Degree in Computer Science  
Montana State University-Bozeman**

**Executive Summary**

In the early 1990's, the College of Engineering at MSU restructured its doctoral offerings into a single degree program (PhD, Engineering) with four specialty options. This was done, in part, due to lagging enrollments in many of the existing programs. The option titles selected represented the strongest research areas at the time. The consolidated program allowed for all COE faculty and students to participate if they could show relevance to one of the four options. This included our computer science faculty and students under the Electrical & Computer Engineering (ECE) option. The College's collective experience with these four specialty options, however, was frustrating in the sense that, without primarily discipline-based titles, emerging areas of teaching and research expertise could not be fully developed. This arrangement also turned out to have been a major constraint in recruiting high quality students and faculty due to the poor visibility of many traditional areas of engineering and computer science.

Thus earlier this year, we requested and were granted approval from the BOR to do a "repackaging" of options to include more traditional, discipline-based titles (Level I approvals, March 20, 2001). These should serve the engineering programs well into the future. However, our computer science program is not fundamentally based in the engineering sciences, though logical connections exist for administrative, resource allocation, and some curricular efficiency. As such, the program has also suffered from the visibility problem with potential students and faculty while under the ECE option. Therefore, the next and final step in the "repackaging" process of the COE doctoral offering is to request that the computer science portion of the current ECE option be split out into a separate degree program to more accurately reflect its own identity. It is felt that an additional option under the current PhD Engineering rubric is not realistic with respect to computer science.

It is emphasized that, while a computer science program currently exists under the ECE option and is modestly successful in enrollments, it logically should be a separate degree from the engineering-oriented options in order to achieve a higher level of productivity. This is seen as a "truth-in-advertising" issue. It is also emphasized that no additional resources are required. This is strictly an issue related to appropriateness of the title. If this request were to be approved, the outcome would be two programs within the COE, a PhD, Engineering (with recently approved options) and a PhD, Computer Science.

**Objectives and Needs**

**1. Centrality to the institution's mission and institutional objectives to be achieved**

**a. Goals and objectives**

The MSU-Bozeman Computer Science Department currently offers the PhD degree through the Electrical & Computer Engineering option of the centralized Engineering PhD degree. Experience has shown that there are a number of problems with this approach. In particular, we find the following difficulties:

- Most advertised faculty openings in CS require the PhD in Computer Science, not in Engineering. Our PhD graduates are disadvantaged by the current degree title when they complete their degrees.
- For graduates entering industry positions (and over ½ of the PhD graduates nationwide take this option), the positions require the PhD in Computer Science. Our students are disadvantaged when they apply for these positions. One of our current PhD candidates works for a Bozeman company, which is sponsoring his research.
- Competition for new doctoral candidates (particularly US candidates) is intense in Computer Science. It is more difficult to attract high quality Computer Science doctoral students into a PhD program named "Engineering" when all of the competing schools are recruiting them into a PhD program named "Computer Science."
- When attempting to hire new faculty at MSU, in a very competitive job market, it is important for us to be able to tell candidates that we have a CS doctoral program in place, so they know that they can attract quality students to work on their research projects. Most CS research is personnel intensive, because of the programming components of the work, and new faculty know that they need doctoral students working with them if they are going to be successful in establishing their research programs. This is particularly true at MSU because of the relatively high teaching loads.
- Visibility is important for any graduate program, and affects both graduate applications and faculty candidates. We find that the current structure does not provide sufficient visibility. E.g., if a potential student were to perform a Web search for graduate programs in CS that offer the PhD, they would probably not find us.

**Intellectual basis for the curriculum**

Computer Science is a well-established research field, with many research sub-disciplines. Currently 165 universities in the North America offer PhD degrees in Computer Science. (Montana is the only state without a PhD degree with that name, although, as noted above, the MSU-Bozeman Computer Science Department does offer the

degree under the Electrical & Computer Engineering option of the Engineering degree.) Areas in which we have research strengths at MSU-Bozeman include algorithms, artificial intelligence, computational biology, computational geometry, computer architecture, computer science education, geographical information systems, graph theory, graphics, image analysis, networking, pattern recognition, parallel computing, program animation systems, scientific visualization, and theory. We will only accept doctoral applicants in areas where we have in-depth research expertise.

#### **b. Course of study**

- The requirements for the PhD in Computer Science will continue to be based on the general requirements for the PhD in Engineering, since it has been healthy to have consistent College-wide procedures and requirements. Specific proposed requirements are described in the sections below. In addition to requirements stated here, students must satisfy all of the MSU-Bozeman College of Graduate Studies requirements and procedures..

#### **Required coursework:**

All students will be required to complete at least 78 credits for their doctoral program, beyond the BS, including at least 18 credits of CS 690 (Doctoral Thesis). Specific courses that must be on every doctoral program are divided into four areas (we already require these courses to be on doctoral programs under the existing degree):

Seminars: CS 500: Seminar (must be taken twice)  
Engr 600: Seminar

Theory & Algorithms: CS 510: Computability  
CS 513: Computational Complexity  
CS 515: Analysis of Algorithms

Systems: Two courses selected from the following:  
CS 518: Adv. Operating Systems & Sys. Progr. Research  
CS 540: Distributed Computing  
CS 545: Parallel Computing Systems  
CS 550: Design & Translation of Programming Languages

Applications: Two courses selected from the following:  
CS 525: Graphics & Scientific Visualization  
CS 530: Pattern Recognition  
CS 535: Database Systems  
CS 536: Advanced Artificial Intelligence

This combination of theory, systems courses, and application courses will ensure that not only will all students have the knowledge base required to pursue research in CS, but also when they graduate they will be able to teach a wide range of CS courses. In addition, all students will be required to complete a supporting course area, which will consist of nine coordinated credits outside of Computer Science. The seminars are included to encourage collaboration between students both within the department and throughout the College. Doctoral programs will include additional courses that are needed to support the students' individual areas of research.

#### **Required teaching:**

1. Since many doctoral graduates in Computer Science take faculty positions in other universities immediately after completing their degrees, it is important that they have strong teaching skills. All doctoral candidates will be required to teach at least two Computer Science courses under the supervision of Computer Science faculty members. They will register for three credits of CS 587 (Teaching Computer Science, 3 cr.) for each course that they teach to meet this requirement, and will be graded by the course supervisor. This new course will include training in university teaching techniques and expectations, as well as applying these techniques by assisting in a Computer Science course.

#### **c. Prospective instructional methods**

We will be using traditional delivery methods for this degree. Doctoral degrees require considerable one-on-one interaction with faculty, and distance delivery is not deemed practical. With improving distance interactive communication systems, we anticipate that in a few years it may be practical to consider distant doctoral students.

### **2. Need for program**

#### **a. Student demand**

We currently have a very strong Master's degree program, described below, which will be a good source of doctoral candidates. We also receive several hundred external enquiries each year, mainly from foreign countries. Despite this, the current doctoral program is far smaller than we would like. The problem has been that it is very difficult to successfully recruit potential CS doctoral students into a degree with the title "PhD in Engineering." The students know that the academic job market for doctoral graduates in Computer Science normally requires that they have a degree called "PhD in Computer Science," as mentioned earlier. With the proposed new title we expect to be able to attract many more qualified students into the doctoral program. This will be assisted by our Master's program, which currently has 43 students enrolled. Although a typical Computer Science MS program has about 60% foreign students and 10-15% women, we have about 15% foreign students and nearly 40% women in our MS program. We know of no other CS graduate program that has managed to recruit such a balanced student body. We have shown that we can be very successful at attracting a strong and diverse group of graduate students, and with the repackaging of the PhD program that we are proposing, we expect similar success with this program. Another strength of our MS program is that most of the students have at least one previous degree in another discipline, which improves their ability to do interdisciplinary research if they enter the doctoral program.

As an example of the confusion caused by the existing degree title, two of our current doctoral students accepted (May 2001) tenure track faculty positions in Computer Science at Montana Tech, before they completed their degrees (which will probably be in 2002). In both cases their appointment letters say that they will receive a salary increase on completion of their PhD degrees in Computer Science. Unfortunately, unless this proposal is approved and they graduate under the new name, their degree will not be in Computer Science but will be a PhD in Engineering with an option in Electrical and Computer Engineering.

We have begun discussions with Al Akhawayn University in Ifrane, Morocco. Their Computer Science Department has requested that we set up an arrangement with MSU-Bozeman where they will send us their top MS graduates for doctoral training in our department, so they can return home after graduation to become faculty there. This will help to substantially increase our initial pool of doctoral students coming into the department. We will be setting up an agreement where initially their students perform most of their doctoral work at MSU-Bozeman, and then as students complete their degrees and their department grows they will, instead, send students to Bozeman for only some coursework. We will also be working on collaborative research projects with their current faculty. In his support letter attached to this proposal, Dr. John Dickinson, the Chair of Computer Science at the University of Idaho, discusses the effect of adding a named PhD in Computer Science at his university. Their degree was added in 1983, and they now have 20 PhD candidates.

#### **b. Economic growth and development**

The MSU-Bozeman Computer Science Department has been part of the recent high technology development in the Gallatin Valley, since much of the expansion has been in software-based companies. There are currently approximately 1,000 information technology jobs in the Gallatin Valley, and this number is expected to double in the next five to seven years. Last year the *Bozeman Chronicle* described the Computer Science Department Head as "a magnet for high technology companies." In addition to existing companies, the new MSU-affiliated TechRanch incubator is specializing in Internet software-based startups. Some of these new companies already need employees with doctoral degrees in Computer Science. For example, Right Now Technologies has hired people with Computer Science doctoral degrees from other institutions.

The most important economic development need for this degree is indirect: if we are to provide the BS and MS graduates who are needed for the ongoing expansion in software-related jobs, we need to be able to attract and retain high quality faculty. This, as we have discussed above, is very difficult without an active doctoral program in place.

A letter of support from Dennis Dixon is attached at the end of this proposal. Mr. Dixon is Director of EDS Montana, President of the Board of TechRanch, and a Director of Gallatin Development Corporation. In his letter he discusses the impact of this proposed degree on economic development in the Gallatin Valley.

#### **c. Reciprocal benefits to the university**

This is a critical reason for this proposal. As a department, we need to be able to hire strong new faculty in a very competitive market at a time when our salaries and teaching loads put us at a disadvantage in competing with many other universities. The faculty we hope to hire expect to find a strong PhD program in place, and without that we have a difficult time persuading them to accept our offers. Computing research has also become central to many other research areas on campus (e.g., the strong research group in Computational Biology). The MSU Computer Science Department is pleased to be part of the multidisciplinary NSF-funded IGERT (Integrative Graduate Education and Research Training) program. If we have doctoral students interested in interdisciplinary research they can collaborate with these other researchers. Another reciprocal benefit is that we have recently been increasing the research base in Computer Science at MSU-Bozeman. Continuing to do this will not be possible without strong doctoral students to collaborate on the research grants. We are also collaborating with other units of the MSU system. Denbigh Starkey is team leader of the computer graphics design team on a research grant headed by Dr. Dan Long of the MSU Northern Agricultural Research Center. This is a multi-state grant that includes researchers from MT, GA, SD, WY, and ID.

## **Adequacy, Accreditation, and Assessment Issues**

### **1. Adequacy of present faculty, facilities, equipment, and library holdings.**

As discussed earlier, this proposal is a significant element of the repackaging of an existing College of Engineering PhD degree program, where the Computer Science Department already offers the PhD degree through the Electrical & Computer Engineering option. We already have the faculty, courses, and facilities in place to support doctoral students in the department, and they are adequate to support the proposed repackaged degree.

### **2. Special accreditation**

Not applicable. Doctoral programs in Computer Science do not receive professional accreditation.

### **3. Assessment Plan**

There are a number of measurable outcomes associated with a doctoral program that we will use for assessment. At this time we have identified the following measures, which we have shown with their anticipated values.

Measure 1: Average number of graduates per year.

Expected: We expect that each tenure-track faculty member will graduate one doctoral student every four years, on average. Although some faculty will be below this average, those with funded research programs should be above the average. Thus, we expect the average annual number of graduates to be the number of tenure-track faculty divided by four.

Measure 2: Successful employment of graduates.

Expected: 80% of the graduates will obtain faculty positions in universities or research-based positions in industry. We anticipate that some of our graduates will take non-research positions in industry.

Measure 3: Percentage of entering students who subsequently graduate.

Expected: 50%. We anticipate the normal attrition seen in all doctoral programs, combined with losing students who take high paying industrial offers.

Measure 4: Student refereed publications.

Expected: An average of two refereed publications per PhD graduate.

Measure 5: Increase in the department's research funding.

Expected: We anticipate a 100% increase by the time that the program is stabilized in five years.

These measures will be used to evaluate the program, and to make changes when needed. It will be some time before we are able to fully implement this assessment process since it takes at least five years before a doctoral program reaches a stable state.

### **Impact on Faculty, Facilities, Costs, Students, and Other Departments on Campus**

As discussed throughout this proposal, this is a repackaging of an existing degree program, and so the faculty, courses, facilities, and equipment needed to support the program are already in place.

#### **1. Additional faculty requirements**

None. Since research in CS is very personnel-intensive, faculty consider working with doctoral students to be an advantage, not a disadvantage. High teaching loads make it nearly impossible to get the research done unless one is working with doctoral students. In Appendix A we give brief vitae for the current faculty. Future faculty hiring, assuming that we are able to continue to justify additional faculty based on our number of undergraduate majors and credits taught, will be aimed at attracting faculty with PhD degrees in Computer Science who can complement our existing research efforts. We will place a particular emphasis on new faculty who are qualified to work on interdisciplinary research.

#### **2. Impact on facilities**

None. The only special facilities required are research computing systems, and we already have those in place to support faculty research and the existing PhD and MS students. (We currently have nearly 50 graduate students in the department.) Although library holdings are minimal to support existing research, the MSU-Bozeman library does carry both electronic and paper versions of all ACM and IEEE journals, which are the core journals for the discipline. The existence of the Internet and inter-library loan has made it possible to search for, and acquire, other journal articles as needed.

#### **3. Costs for first year and first biennium**

As discussed above, there will be no additional costs associated with this proposal.

The impact on other departments will be positive. Computer Science is an application discipline, similar to Mathematics. The existence of a vibrant doctoral program in CS will provide more opportunities for collaborative research throughout the campus, and possibly with other campuses. E.g., Brendan Mumey is one of the co-PIs on a large multidisciplinary IGERT grant to support graduate students in complex biological systems. The proposed new doctoral program will make it much easier to attract CS doctoral students who would be supported by IGERT, and would be working with other researchers and students across campus.

#### **Appendix A: Brief Vitae for Current Tenure-Track Faculty**

##### **Bob Cimikowski**

Associate Professor of Computer Science  
BA, Mathematics, Fordham University, 1972  
MS, Computer Science, Worcester Polytechnic Institute, 1984  
PhD, Computer Science, New Mexico State University, 1990  
Research areas: Graph theory, analysis of algorithms.  
Current research funding: *Optimal Linear Arrangement Algorithms*, National Center for Supercomputing Applications (NCSA), 2001-2002, 1000 system units.

##### **Gary Harkin**

Professor of Computer Science  
BS, Industrial & Management Engineering, Montana State University, 1973  
MS, Industrial & Management Engineering, Montana State University, 1974  
PhD, Computer Science, Washington State University, 1988  
Research areas: Image processing, pattern recognition, parallel systems, artificial intelligence, computer architecture.  
Current research funding: BNCT Treatment Planning Software, INEEL/DOE, renewed each year since 1991 (PIs have included Harkin, Babcock, and Starkey), \$50,000 per year.

##### **Brendan Mumey**

Assistant Professor of Computer Science  
BSc, Computer Science, University of Alberta, 1990  
MSc, Computer Science, University of British Columbia, 1992  
PhD, Computer Science and Engineering, University of Washington, 1997  
Research areas: Computational biology, graph algorithms, theoretical computer science, scientific computing.  
Current research funding: 1. *Computational Neuroscience Problems with Application to Microarray Expression Analysis*, National Science Foundation, 2000-2001, \$95,649.  
2. *Structural and Functional Analysis of Complex Biological Systems*, National Science Foundation IGERT program, (with several other PIs), 1999-2004, \$2,699,300.

##### **John Paxton**

Associate Professor of Computer Science  
BS, Computer Science (minors in Mathematics and German), The Ohio State University  
MS, Computer Science, University of Michigan, 1987  
PhD, Computer Science (minor in Artificial Intelligence), University of Michigan, 1990  
Research areas: Artificial intelligence, computer science education.  
Current research funding: *A Scheduling Investigation*, Raytheon Corporation, 2000-2001, \$40,000.

##### **Rocky Ross**

Professor of Computer Science  
BA, Mathematics, Washington State University, 1970  
PhD, Computer Science, Washington State University, 1978  
Education Editor (since 1990) for SIGACT, the primary CS Theory professional organization  
Research areas: Computer science education through animation, theory of computation, compilers, formal language theory.  
Current research funding: 1. *WebBook: A Prototype for the Next generation of Interactive Computer Science Learning Resources*, The National Science Foundation, 2001-2002, \$74,717. 2. *Moving Biofilm Research into Teaching: A Prototype Interactive Web-Based Approach*, (with Al Cunningham of the Center for Biofilm Engineering), The National Science Foundation, 2001-2002, \$74,942.

##### **Denbigh Starkey**

Department Head & Professor of Computer Science  
BA, Honour School of Mathematics, Oxford University, England, 1968  
PhD, Computer & Information Sciences, University of Pennsylvania, 1972  
Research areas: Computer graphics, scientific visualization.  
Current research funding: *Modeling and Visualizing Remote Sensing and Terrain Data for Research and Education in Precision Agriculture*, (with researchers from five states, primary PI is Dan Long, MSU Northern Agricultural Research Center), United States Department of Agriculture, IFAFS Program, 2001-2004, recommended for funding at \$800,000 (Denbigh Starkey's component as team leader of the graphics design team: \$83,010).

### **Year-Back Yoo**

Associate Professor of Computer Science

BS, Astronomy, Seoul National University, Korea, 1970

MS, Computer Science, Washington State University, 1979

PhD, Computer Science, Washington State University, 1983

Research areas: Analysis of algorithms, parallel algorithms, operations research.

Former Director of the Korean National Supercomputing Center.

Current research funding: *Parallel Algorithms for Some Combinatorial Optimization Problems*, Pittsburgh Supercomputing Center, 2001-2002, 10,000 system units.

### **Binhai Zhu**

Associate Professor of Computer Science

BSc, Computer Science, Shandong University, China, 1986

MSc, Computer Science, York University, Canada, 1991

PhD, Computer Science, McGill University, Canada, 1994

Research areas: Applied computational geometry, GIS, algorithms.

Current research funding: *Approximations for geometric optimization problems*, Hong Kong Research Grant Council, 1999-2001, \$85,000. *Approximating 3D Polyhedra with Cylinders and its Application to Neural Maps*, MONTS, 2001-2002, \$25,000.

In addition to these eight tenure-track faculty members, we have four adjunct faculty who will not be directly involved in the doctoral program. All four adjuncts have MS degrees in Computer Science. We also have one Research Associate Professor, Dan Wessol, who is funded by the Idaho National Engineering and Environmental Laboratory (INEEL) to perform joint research with Computer Science faculty and students to work on the BNCT cancer therapy project. He is a full time INEEL scientist who has been on outplant status in our department for several years.

### **Appendix B: Letters of Support**

**Dennis Dixon** Director, EDS Montana  
President of the Board, TechRanch (a Bozeman business incubator)  
Director, Gallatin Development Corporation

Mr. Dixon was asked to write a letter because he is central to the economic development efforts in the Gallatin Valley. Dennis' letter was received as an email attachment.

**David Bakken** Assistant Professor of Computer Science, Washington State University  
Chair, CS Faculty Search Committee, Washington State University

Dave provides the perspective of a relatively new PhD in Computer Science, and also of the current chair of the search committee for Computer Science faculty at WSU, where they are attempting to fill five openings. Dave's letter was received in hard copy and has been scanned into this proposal.

**John Dickinson** Chair, Computer Science Department, University of Idaho

John provides the perspective of the Chair of a Computer Science Department in our region where the PhD degree was added in 1983. His letter describes the positive effects from this change including the ability to establish a solid doctoral program (currently they have 20 PhD students), and a tenfold increase in their research expenditures. John's letter was received in hard copy and has been scanned into this proposal.

**John Cherniavsky** Senior Advisor for Research, Education and Human Resources Directorate  
National Science Foundation (NSF)

John has held many of the top positions in the CISE and EHR Directorates at the NSF. He is very familiar with Computer Science doctorate programs throughout the US. His letter was received in rich text format, and is attached to this document.

**David Nigg** Manager, Nuclear and Radiological Sciences  
Idaho National Engineering and Environmental Laboratory (INEEL)

Dave provides the perspective of a senior research manager at INEEL, our closest National Engineering Laboratory. Dave's letter was received in hard copy and has been scanned into this proposal.



September 10, 2001

Dr. Denbigh Starkey  
Department Head & Professor  
Computer Science  
Montana State University

Dear Sir:

I support your request to create a separate and distinct PhD of Computer Science at Montana State University.

The Computer Science discipline fuels the Information Technology industry, which is the fastest growing private sector industry in the world, with continued expected strong growth for the foreseeable future. It is a distinct field of its own, with an extremely robust labor market in which demand greatly exceeds supply.

In the Gallatin Valley alone, Information Technology firms account for over 1000 jobs. It is expected that over 1000 new technology jobs will be created here in the next ten years, many of which will require Computer Science degreed people to fill.

In my role as Director of EDS Montana, a Fortune 100 company, I have personally hired 69 people in the last four years, almost all of whom possess at least a Bachelor's degree in Computer Science.

In my roles of President of the Board for TechRanch (a technology business incubator), and as a Director of the Gallatin Development Corporation (an economic development organization), I am actively involved in creating more new Information Technology jobs in Montana.

We need a strong and recognized Computer Science doctoral program in MSU to attract the necessary qualified faculty to produce the high quality undergraduates and graduates required to fuel the economic growth we are producing for Montana.

Sincerely,

Dennis Dixon

Director

# Washington State University

School of Electrical Engineering and Computer Science

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509-335-6602  
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April 23,2001

J. Denbigh Starkey  
Professor & Head, Computer Science  
357 EPS  
Montana State University  
Bozeman. MT 59715

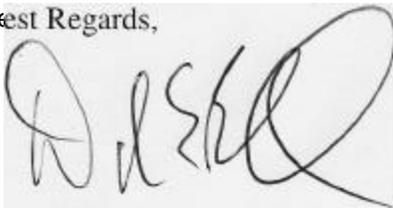
Dear Professor Starkey:

I have read your document "Doctor of Philosophy in Computer Science: Draft Level II Proposal" which you recently sent to me. I strongly agree with your proposal and the underlying premises and supporting details stated in this document.

I have experience not only as a new faculty hire here two years ago, but I am in charge of computer science recruiting this year. From that perspective, I can say with great confidence that having a separate PhD in Computer Science at Montana State University-Bozeman will help in you faculty recruiting; without it you are at a serious disadvantage. It will also give your Computer Science PhDs an appropriate classification for their degree, which will help them when they apply for faculty and research jobs.

I hope that you can get this program approved, because it will greatly benefit your university and your state. Good luck in doing so!

Best Regards,

A handwritten signature in black ink, appearing to read "D. Bakken", written over a light gray rectangular background.

David E. Bakken, Ph.D.  
Assistant Professor



# University of Idaho

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Dr. Denbigh Starkey  
Department of Computer Science  
EPS 357  
Montana State University  
Bozeman, MT 59715

Dear Dr. Starkey,

I have read the "Doctor of Philosophy in Computer Science Draft Level II Proposal" and I am pleased to comment on it. I believe that there is a very strong need for a PhD program at Montana State University because there is a very strong demand for new PhD graduates. The Computing Research Association surveys all of the PhD producing computing departments and publishes the results as the Taulbee Survey. This survey is the principal source of information on the enrollment, production, and employment of Ph.D. 's in computer science (CS) and computer engineering (CE) and in providing salary and demographic data for faculty in CS & CE in North America. The survey is named after Owen E. Taulbee, University of Pittsburgh, who conducted these surveys from 1974 - 1984 for the Computer Science Board (the predecessor organization to the Computing Research Association). The survey has always had an excellent response rate, which lends great credibility to the results.

The 1999-2000 Taulbee Survey appeared in the March 2001 Computing Research News. It indicates that the current production of PhDs in CS & CE will be unable to supply the demand by education and industry for PhDs. About 900 new PhDs graduated last year and about 42% of the PhD graduates enter university departments. But while about 370 new PhDs were being hired, there were 127 current faculty members who were hired by one institution from another. This is a very strong indicator of supply problems. The CS & CE departments estimate a 20% growth rate and this growth cannot occur by one department raiding another.

There are several key points within the proposal that I believe are very true and need to be highlighted.

1. Graduates with a PhD degree in computer science are in high demand. The supply is not coming close to meeting the need. The Taulbee survey contains data to support this conclusion.
2. The existence of a PhD program within a department makes it easier to attract and retain faculty. It is difficult to build a department full of quality faculty without the PhD program.
3. The existence of a PhD program within a department makes it easier to attract and retain students at all levels. Undergraduate students are attracted to a school where they can participate on research projects, gaining valuable real-world experience. Graduate students are attracted to a department with a variety of long-range research projects underway, the kind associated with and needing PhD students.
4. The State of Montana is without a PhD program in CS. A PhD program at Montana State University would help within the state in the economic development of high technology areas.

I believe that it might be helpful to hear some of the experiences at the University of Idaho related to the introduction of the PhD program in computer science. The PhD program in computer science was approved by the State Board of Education in 1993. Since that time we have graduated seven PhD students and two more plan to graduate in May 2001. All of these students have been able to find employment in educational institutions. At the present time we have a little of 20 PhD graduate students. Since the PhD program began the department has been able to attract and retain faculty of the highest quality. As an indication of the expertise of the faculty, the research expenditures for the department have risen from under \$200,000 in 1993 to over \$2,000,000 in 2001. Undergraduate and graduate students are being involved in a wide range of research projects. I believe that the educational experiences of all the students within the department have been enhanced.

I believe that the introduction of a PhD program in computer science at Montana State University is a good idea and I encourage those of you who are making decisions about this to approve it. It will help the state, the institution, the faculty, and the students.

Sincerely,

John Dickinson  
Chair, Department of Computer Science

To enrich education through diversity the University of Idaho is an equal opportunity/affirmative action employer

15 May 2001

Dr. Denbigh Starkey  
Department Head, Computer Science  
Montana State University  
Bozeman, MT 59715

Dear Dr. Starkey,

This letter is in response to your request for comment on your planned Ph.D. program in Computer Science. My response is based upon my general knowledge of computer science graduate programs and not a reflection of general NSF policy or advice.

The Computer Science Ph.D. is a relatively young degree (the first programs started around 1960) with a substantial number of programs - almost 200 in the U.S. The programs generally arose from one of three loci - mathematics, engineering, or business. The mathematics programs began with strong emphasis on numerical analysis and theoretical computer science, the engineering programs had a strong emphasis on hardware and communications theory, and the business programs had strong data base and information management systems emphasis. Over time these programs converged to where there is now a well understood body of knowledge that every computer science Ph.D. is expected to have mastered. That body of knowledge is reflected in your required coursework for the Ph.D. and reflects the undergraduate teaching expectations of universities for new Ph.D.s in computer science..

The Ph.D. in most engineering programs is substantially different from the Ph.D. in computer science. There is much stronger emphasis on design principles and typically much more applied dissertation work. Engineering schools hire engineering Ph.D.s and since many CS departments are not in engineering colleges, students with engineering degrees might be at a disadvantage in applying for jobs.

In summary, I support your plans for a separate Ph.D. program in computer science. It is consistent with what other universities are doing and could, in particular, serve students who are now in your Master's degree program.

Sincerely yours,

John C. Cherniavsky  
Senior Advisor for Research  
Education and Human Resources Directorate  
National Science Foundation



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May 2, 2001

Dear Dr. Starkey:

I have reviewed the draft proposal for a separate Computer Science Ph.D. program at MSU and I can certainly comment favorably on it. However, please note that my comments on the proposal are from a National Laboratory point of view, which is somewhat different than the academic point of view around which the proposal is largely constructed.

First, it seems quite reasonable to me that Computer Science should be considered as a separate (although closely related) discipline from Electrical Engineering. When I was in school (early 1970s) at the University of Kansas, this distinction had already emerged. Students whose primary interest was in software and operating systems would take their major in Computer Science, while those whose primary interest was in hardware and circuit design would of course enroll in Electrical Engineering. There were two completely separate degrees, all the way through the doctoral level if I remember correctly, and there were two separate university departments, although each would, for obvious reasons, require its students to take some prerequisite courses in the other department. According to your proposal, this is the common pattern at most, if not all, other universities that offer both disciplines, so it stands to reason that MSU should follow suit, as you pointed out.

Second, I can offer some comments based on observations that I have made during the last 25 years at INEEL. In a National Laboratory environment, much of the work generally involves applications software development rather than "pure" computer science such as operating system maintenance, etc. Given this, we have often found (at least in my experience) that in most cases computer science expertise is most valuable in an employee when it is coupled with a strong background in one of the natural science or engineering disciplines. That way, a person who is developing application software in our environment not only has the required programming and algorithm development expertise, and the knowledge of how to best exploit the features of a given operating system and hardware platform, but they also have a good grounding in the actual applications to which their efforts will ultimately be put to use. Basically, they can see things from the end user's point of view, and they are better equipped to be able to tell whether the software is working properly. As you know, the fact that a program will run to completion does not necessarily mean that it is giving the right result, or even a physically realistic result.

We do, of course also need some folks whose primary expertise is in operating systems, networking, and other non application-specific topics, just to keep our extremely large and complex laboratory-wide system working properly, and in tune with the latest technological developments. Furthermore, we have a baseline requirement for a cadre of programmers who maintain our business and accounting systems (although this latter function is probably not a doctoral-level assignment). However, I would say that the substantial majority of computer related activities in our environment are oriented toward specific scientific and engineering applications. Thus, from my experience, I believe that a doctoral program in Computer Science should definitely include some requirements for a secondary subject area concentration in an applications-related discipline, unless the individual genuinely wishes to focus totally on some aspect of computer science that is truly application-independent.

So, for what it is worth, that is how I see things based on my own experience. I hope my comments are useful. Good luck with your efforts.

Best Regards,

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