Self-Study of Graduate Programs in CIS at KSU

Draft

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Abstract

The primary purpose of this document is to allow the graduate faculty of the KSU CIS Department to evaluate the strengths and weaknesses of our graduate programs, and to prepare a vision for our graduate education over the next five years. This evaluation is one component of a self-study of all graduate programs at KSU, in preparation for a statewide graduate program review to be conducted by the Kansas Board of Regents.

1 Graduate programs and our departmental mission

The Department of Computing and Information Sciences sees its mission as encompassing the interrelated areas of undergraduate and graduate education, outreach, and research. We offer computer literacy courses to students in all academic disciplines to empower them to function in the information age. We offer Bachelor of Science and Bachelor of Arts degree programs in both Computer Science and Information Systems. At the graduate level, we offer Master of Science and Doctor of Philosophy degree programs in Computer Science, as well as a Master of Software Engineering degree program. Many of our graduate-level courses are offered to off-campus computing professionals via video tape, the Internet, and 5-week Summer on Campus courses. In particular, our MSE degree is structured as an interdisciplinary outreach degree to provide a channel for technology transfer to industries in Kansas and across the U.S. Our faculty are actively involved in such research areas as programming languages, distributed and real-time systems, software engineering, and database systems.

Our graduate programs form an integral part of the Department's overall mission, and cannot be separated from the areas of undergraduate education, outreach, or research. A majority of our on-campus graduate students hold GTA appointments that involve them in teaching or grading in our undergraduate courses. Conversely, our undergraduate degree programs prepare students for graduate education. Our outreach courses at the graduate level foster a symbiotic relationship between our full-time on-campus graduate students and off-campus professionals seeking to enhance their formal education in computing. Our graduate students assist faculty members in their research, and, as a result of these close working relationships, learn to conduct, present, and publish scholarly research themselves. Furthermore, our faculty share with our students what they have learned in their research through regular courses, special topics courses, and seminars. Our graduate students gain an even broader exposure to academic and applied research as a result of faculty collaborations with researchers across the University and around the world, through regular visits of internationally-recognized researchers, and through opportunities to referee submissions to academic conferences and journals.

Our Department is involved in a number of specific activities to enhance our graduate education. Our faculty who teach off-campus courses invest a significant amount of time in tailoring these courses to the appropriate media. We continually update our graduate-level courses as knowledge of computing expands. We invite speakers to give talks of interest to graduate students. We regularly review our graduate programs and our admissions standards so that we can continue to provide a quality education. We advertise our graduate programs through posters, the World Wide Web, international publications, and recruiting visits to nearby campuses. We seek funding from industrial and government sources to help support our graduate students and to provide state-of-the-art computing equipment for their use. We interact with Farrell Library to ensure ready access to important publications.

2   The need for Computer Science graduate programs

The Department offers its graduate programs for two main reasons. The first reason is because there is a strong external demand that we do so. Computer science is the basis

for much of today's technology and business. Many corporations, both in Kansas and nationally, are dependent on the skills of computer science professionals who are knowledgeable in the state of the art and state of the practice in computer science and software engineering. Computing professionals who develop mission- or safety-critical applications must be especially highly trained. As a result, industry is demanding increasingly large numbers of computing professionals who have received graduate-level training in computer science—which explains why our graduate programs (and graduates) are in high demand. We offer our outreach programs since many computing professionals need to augment their training by taking graduate courses, or engaging in part-time master's study, while continuing in full-time employment, and without being resident in Manhattan. And, our MSE program provides the training needed by practicing engineers, without extensive formal training in computing, who find themselves responsible for developing computer systems in the course of their work.

The second reason that we offer our graduate programs is less obvious than—but of equal importance to—the first one: because of how these programs affect our ability to carry out our overall departmental mission, which also includes research, technology transfer, and undergraduate education. A department without graduate programs cannot be successful at research or technology transfer. Graduate students carry out their own research and development projects, of course, but they are also involved in faculty-lead projects. Such projects would have to be much less ambitious, if the research and development work couldn't be shared between faculty and graduate students. The intellectual environment of our department is immeasurably improved by the presence of young, keen graduate students. And the process of graduate teaching often leads our faculty to research discoveries. Perhaps more surprisingly, our graduate programs also have a positive effect on our undergraduate programs. Since computer science is a young discipline, especially when compared with subjects like physics and mathematics, even the material taught in undergraduate courses is rapidly changing. Research developments flow into graduate teaching and then undergraduate teaching at a rapid pace. We believe that faculty who are not actively involved in research and graduate teaching are unlikely to keep up with the developments in their field, and thus are unlikely to continue to excel at undergraduate teaching.

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3 Evaluation

In this section, we will evaluate each of our three graduate programs. Because the quality of a department's research programs is directly related to the quality of its graduate programs, we will then give an evaluation of our research. We will conclude the section with an evaluation of our Summer on Campus Program.

3.1 Master of Software Engineering Program

The MSE program meets a need for advanced technical education for professional software developers. This need has resulted in a strong growth of this degree program in two different ways. First, there has been a steady increase in the number of off-campus professionals taking courses to improve their skills and to work toward the masters degree. Second, because the MSE provides an opportunity to integrate software development with other fields of study, there has been a tremendous increase in the number of applications to the MSE program from graduates of other disciplines. As a result, the number of MSE students has grown to 44 in Fall, 1996, its second year of existence.

The MSE program distinguishes KSU as being one of a select few universities to offer an MSE degree. Inquiries and applications have come from all regions of the country and the world. Several students who would otherwise have studied Software Engineering in our MS program have switched to our MSE program; however, the majority of applications have come from professionals seeking to enhance their computing expertise and from students with degrees in other fields.

3.2 Master of Science Program

The MS program has produced an average of 30.8 graduates over each of the past five years. These graduates account for over half of the graduate degrees awarded by the College of Engineering each year. Most of these graduates are now employed in the computing industry, and a few are in PhD programs. Furthermore, the quality of these students has continued to improve due to ever stricter admissions standards. For example, we no longer admit all students that meet all of the objective criteria listed in our minimum

requirements; instead, we now consider all of the qualifications together, and try to admit only those that we feel will be successful. As a result, the quality of our students has improved, so that we can now cover more material in our classes than we could in the past.

The number of on-campus students in our MS program has declined over the past two years. One reason for this decline is that the number of applications from international students has dropped sharply since the University began collecting the application fee for international students. In addition, several of our MS students have transferred to our MSE program, and others who may have otherwise applied to our MS program have instead applied to our MSE program. The net increase in enrollment in these two programs combined is a sign of health for our Masters programs. Furthermore, our stricter admissions standards have certainly contributed to the decrease enrollment in our MS program. Finally, because employment for computing professionals is in extremely high demand with correspondingly high salaries, fewer students with Computer Science bachelor's degrees are interested in pursuing graduate study in Computer Science. Although the quality of our MS program remains strong, we have recently increased our recruiting efforts (i.e., by visiting nearby colleges and universities and mailing out announcements of fellowship opportunities) in an attempt to reverse the decline in on-campus enrollment.

3.3 PhD program

The PhD program has produced an average of 3.6 graduates over each of the past five years. Most of these currently hold either postdoctoral or tenure-track positions at research universities; others are working in industrial or defense positions (see Table 1). The quality of these graduates is closely tied to the quality of the faculty research programs, which we will discuss shortly.

Our most pressing concern regarding our PhD program is the recent decline in the number of students. There are several reasons for this decline. First, in the recent booming job markets, in particular for computer programmers, engineers, and scientists, graduates of Computer Science bachelor's and master's programs can easily obtain good industrial jobs with competitive salaries. Second, university positions have recently become more

Graduate	Employer	Position
Anindya Banerjee	Stevens Inst. of Technology	Assist. Prof.
Eric Byrne	Univ. of Texas-Arlington	Assist. Prof.
Jim Butler	Company	Partner
Kyung-Goo Doh	Hanyang Univ. (S. Korea)	Assist. Prof.
Adrian Fiech	Memorial Univ. of Newfoundland	Assist. Prof.
Steve Hansen	Univ. of St. Thomas (Minnesota)	Assist. Prof.
John Hatcliff	Oklahoma State Univ.	Assist. Prof.
Mary Lou Hines	Univ. of Missouri-Kansas City	Assist. Prof.
Karoline Malmkjær	Stibo Datagraphics	Computer Scientist
Mitch Neilsen	Kansas State Univ.	Assist. Prof.
Dennis Ng	Brigham Young Univ.	Assist. Prof.
Mohammad Paryavi	IBD Informatics	CEO
Sheila Ramana	Unknown	
Jim Slack	Mankato State Univ. (Minnesota)	Assist. Prof.
Joo Tan	Tekmark Computer Services	Software Consultant
David Toman	Univ. of Toronto	Postdoc
Pei-Kun Tsai	TechExcel	Partner
Bill Young	Air Force	Officer

Table 1: PhD Graduates in Fiscal Years 1992-1996

difficult to obtain. For example, in 1987, this department received about 70 qualified applications for faculty positions. Since 1990, we have consistently received over 200 qualified applications each year. The decline in the number of PhD students is a national trend, and many highly ranked Computer Science departments have been struggling to keep good PhD students. Over the past few years, many of our PhD students have opted to leave early with an MS degree. We also suspect that we are losing prospective students to universities who are able to offer larger research stipends. In order to reverse this trend, we have recently begun to intensify our efforts to recruit PhD students.

3.4 Faculty Research

A shortage of faculty and equipment resources has hurt our department's national research ranking. In the latest NRC ranking (for the period 1988-1993) of faculty quality, our department ranked 82nd out of the 108 Computer Science departments that took part in the review. Compared to the Computer Science departments of our peer institutions and

Ranking group	Average faculty size
1-10	38.5
11-20	27.6
21-30	25.1
31-40	22.7
41-50	20.4
51-60	24.6[a]
61-70	19.5
71-80	15.4
81-90	15.6
91-100	13.5

[a]skewed by CUNY, who has 56 faculty

Table 2: Comparison of NRC ranking with faculty size

KU, we ranked better than KU (86) and Oklahoma State (108), but ranked somewhat lower than Iowa St (78), Oregon St (71) and NC State (60). More encouraging, we ranked 22nd in the nation in terms of most improved department in the period 1988-93, which supports our feeling that the department is continuing to improve. This ranking is better than that of all of our peers; KU's improved rank is 98. Furthermore, the NRC survey made use of outdated numbers (e.g., our faculty count in 1992 was 15.6 not 11), and the correct numbers would have worked to our advantage. We expect that our ranking will improve again in the next NRC survey.

There is a very strong correlation in the NRC rankings between departmental size and overall ranking, which is summarized by Table 2. Thus, unless our departmental size dramatically increases, it seems unlikely that our NRC ranking will ever become better than about 70. Why does this correlation between faculty size and ranking exist? It seems that this is because the NRC ranking takes into account the breadth of research carried out by a department, whereas small departments like ours must focus on depth, i.e., on achieving excellence in a small number of research areas. In our department, we carry out high quality research in three areas (programming languages, distributed and real-time systems, and software engineering), and are in the process of building up our research program in database systems.

The programming languages group has been active since 1996, and currently consists

of three faculty members (one Full Professor, one Associate Professor, and one Assistant Professor). The group is internationally recognized. It has hosted extended-term visitors from the Universities of Rennes, Copenhagen, and Glasgow, as well as short term visitors from the Universities of Aarhus and Darmstadt, Carnegie Mellon University, and Oklahoma State University. It is a participant in the NSF Atlantique exchange program. Group members are currently collaborating with researchers at the Universität des Saarlandes, Imperial College, and the University of Birmingham. Members of the group have been invited participants at numerous workshops, and have been funded visitors (by the host institutions) for one month or longer to the Universities of Copenhagen, Aarhus, Glasgow, Edinburgh, Ecole Normale Superieure, and Darmstadt. The group has an extensive publications record, and group members have authored three books and edited two special journal issues. One group member has served twice as a program committee co-chair, and is on the steering committees for the Mathematical Foundations of Programming Semantics Conference series and the Static Analysis Symposium series. Group members have served as program committee members for more than one dozen conferences. The group has received over $760,000 of funding in the last six years, including continuous NSF funding and occasional funding from ONR and DARPA.

The distributed and real-time systems group consists of five faculty members (one Full Professor, three Associate Professors, and one Assistant Professor). The group has research links with INRIA, IRISA, University of Rennes, Ohio State University, Hiroshima University, and Bell Communications Research. Two group members have served as program committee members for a total of three conferences, and one of these members has served as the conference stream chair of the 1991 ACM Symposium on Applied Computing. Another participated in the development of the SAE J1939 standard for in-vehicle networking and the development of the NMEA (National Marine Electronics Association) 2000 standard for real-time networking in marine craft, established a system for delivering interactive television that lead to two patent applications, and is active in the Precision Agriculture Group at KSU. The group has received over $670,000 of NSF and DoD funding in the last six years.

The software engineering group consists of three faculty members (two Full Professors and one Assistant Professor). It has links with researchers at Oklahoma State Univer-

sity, and the Universities of Massachusetts and Hawaii. The group was instrumental in the founding of the grubstake group, an internationally-known group of researchers in the software measures area. The publications of the grubstake group are cited by most researchers in software measurement. One of the group members was recently awarded an NSF Career Award of $200,000.

3.5 Summer on Campus Program

Our Summer on Campus Program is an extension of our MS and MSE programs. Since 1980 the we have offered a summer program for computing professionals who are seeking Master's Degrees in Computer Science. Each student spends five weeks on the KSU campus each summer until they have satisfied the requirements for their degree. This process takes three to five summers, depending upon the number of credits transferred from other universities and the number of courses they have taken through our remote electronic delivery mechanisms (live TV through satellite and compressed video, videotape delivery, and soon to be PC-based delivery). Each student enrolls in two (3 credit) graduate level classes for that five weeks, for which they spend four hours per day in the classroom.

Over each of the past five summers, we have averaged 60.6 students in the Summer on Campus program. Furthermore, this program supports itself, bringing in over $1,500,000 in extramural funding over the past five years. Thus, this program produces half of all of our Master's graduates at no cost to the University.

4 Goals

In this section, we will outline our five-year goals for each of our graduate programs, as well as for our research programs.

4.1 Master of Software Engineering Program

The goals of the MSE program include continual growth and improvement of the program into an internationally-recognized program. This includes both increasing its visibility in the industries of the central region of the country and developing the distance learning into a mature teaching methodology.

Both efforts require additional support. To be a strong program, we will need to visit many industries in the area to promote the program and to obtain feedback about needs and concerns. The feedback that we have received has been very positive, although it has been limited to about ten organizations. Additional industrial contacts are essential.

Distance learning is currently based on video tapes as the main delivery medium. There are many drawbacks to this approach. The future of distance learning will be increased use of multimedia in lectures and student-teacher interaction. This will require access to higher speed networks, including internet2, and acquisition of more hardware and software to provide access for both faculty and students.

Because the MSE has a strong interdisciplinary flavor, we will work to integrate more faculty outside of this department into our MSE program.

We will also consider developing a Software Engineering Certificate comprised of roughly 18 credit hours. Such a certificate is needed by industry, and would complement our MSE degree.

4.2 Master of Science Program

Our most immediate goal for our MS program is to improve our recruiting efforts. Although we feel that our current MS enrollment is adequate, we don't want to see the decline in on-campus enrollment continue. Apart from increasing the number of students in our MS program, improved recruiting efforts can help us to attract better students. We have recently begun making recruiting visits to nearby colleges and universities. In addition, we intend to review our advertizing materials and the way we respond to inquiries into our program. We will also explore new ways of initiating contact with quality under-

graduates. We hope to be able to increase the amount of our GTA and GRA stipends in order to be more competitive financially.

Concerning the MS program itself, we will soon be re-evaluating the different degree options. Currently, our MS degree requires either a thesis plus 24 hours of coursework, a report plus 28 hours of coursework, or 33 hours of coursework only. With the presence of the MSE degree, it is now time to consider whether all three of these options continue to be needed. We will also seek out ways to facilitate more interdisciplinary MS degrees, particularly in Computational Science and Engineering.

4.3   PhD Program

Lack of resources has hurt our PhD program. Good students are going to bigger and better-funded departments. Our top priority for the PhD program is recruiting. In fact, our top priority in recruiting is in recruiting PhD students. As a means of attracting PhD students, we will seek to obtain grants for PhD fellowships. These grants would likely come from federal sources with matching state funds. Our goal is to increase our total number of PhD students to 25. It is obvious that students' interests in PhD programs are directly affected by the job market, in particular University jobs. Even though it is difficult to predict the future of the University job market, the market seems to have been getting slightly better for graduates over the last two or three years. As a result, we may be able to attract, keep, and produce more PhD's in the near future. In order to support this many PhD students, we will need to increase our faculty size, as well.

We would like to facilitate more interdisciplinary work in our PhD program. We will give careful consideration to this possibility.

4.4   Research

We need to strengthen our research efforts in the three established areas of programming languages, distributed and real-time systems, and software engineering, and to build up our database systems research group. We would also like to increase collaboration with other departments at KSU. We are currently trying to fill open faculty positions with re-

searchers in experimental computer science and database systems. Our goal is to increase the size of our department to 20 faculty members. Some increase in the size of our faculty appears to be necessary, as we anticipate our undergraduate enrollment to increase to 400 majors in the next five years. Furthermore, if we succeed in expanding our PhD program to 25 students, we will need more faculty to give them the attention they need. Having 20 faculty members would allow us to reduce our teaching loads to three courses per year without cutting our course offerings. Such a teaching load seems necessary if we are to continue to improve the quality of our research and our national ranking. Furthermore, an increase in faculty size may allow us to improve our national visibility and to attract more PhD students by adding an additional research group.

In addition, we will need to increase the amount of external funding that the department receives, ideally by a factor of two. This will probably mean proposing some large, collaborative projects and going after more Department of Defense and industrial funding. In order to attract funding for such projects, we will need significant parallel computing facilities, which would benefit all of our department's research groups.

5 Summary

In summary, this department has done an exemplary job in maintaining undergraduate, graduate, and research programs in spite of minimal resources. For this department to achieve the next tier of recognition, additional resources are needed. Increasing populations of undergraduate and MSE students make an increase in faculty size essential. Furthermore, there is a strong correlation between faculty size and national ranking. Funding agencies, such as NSF and DoD, tend to base their funding decisions in part on national rankings. Even with a shortage of resources, the quality of our programs is improving significantly; hence, an investment at the present time seems certain to yield a tremendous dividend later.