

1990 Annual Report
Dept. of Computing and Information Sciences
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I. Preface

This has been a rewarding year for CIS. We hired two new faculty who have enhanced both our teaching and research productivity. The faculty, in general, have increased research productivity, been involved in many professional activities, spread the KSU word across the globe, and been conscientious in transferring knowledge to "budding" new computing scientists. The faculty are generating more research proposals and concentrating on acquiring a national reputation for the Department. We have a young and exciting faculty to match our young and emerging discipline. We are working to make our research and instructional programs relevant. We want to work with other disciplines to enhance their research programs with the computational engineering and science research (computational modeling, computational control, database access, software engineering capacity, etc.) paradigm. Work in this area shows great promise for increased funding through the "high performance computing initiatives" in Congress today. We also want to be involved in the training of MS and PhD students in computational engineering and science. It is projected that there is a need for 1000 PhDs in this area by the year 2000. (See the section on Strategic Planning for more details). In short, we are excited about our field and its contribution to the University, the State, the Nation, and the World. The world is now a global village and computing and information sciences is a focal point for much of the technology and theory to enable the societies of our world to intermingle with a diversity of cultural, industrial, business, governmental, research, and educational activity. Our faculty understand this societal impact of our technology and want to further its goals.

This has also been a very frustrating year. For the first time in its history, CIS has succumbed to the "survival mentality" that so pervades KSU. In the past, we have always viewed underfunding as something we could overcome. We always had too many students, too little equipment, too few faculty, and (as a result) too little time for research. But we have always heard "lip service" from central administration on how important CIS was to the University. Thus, we continued to overextend, gambling that the University would sooner or later believe that CIS was important, that Computer Science was actually to receive funding to accomplish the mission set forth by the Kansas Board of Regents in naming Computer Science as a central thrust of the University. However, it is becoming more clear to the faculty and students each year that no significant increase in support is imminent. Thus, they are depressed and letting the traditional KSU "survival mentality" set in.

Let us be more specific. While the Department has acquired more than \$4 million dollars worth of computing equipment, software, and networking in the past several years, the University has provided less than \$150,000 in the past 3 years for upgrade and maintenance of computing labs for CIS. Furthermore, while the Department has been requesting a laboratory fee since 1982 to partially cover these costs, none has been supported by central administration. Our peers receive from \$100,000 to \$300,000 annually for this purpose. We currently are a faculty of 15, while the national average for PhD-granting Computer Science departments is 20 faculty members and the top 24 Computer Science departments average a faculty size of 28. Our OOE budget is 50% of the OOE of our sister department at KU, while we are essentially the same size in terms of number of students, equipment base, and faculty size. Faculty at the full professor level received 25% less salary than our peers; associate professors' salaries are 15% deficient in comparison with our peers; and assistant professors receive salaries which are 6% below their peers. GTA stipends are approximately 20% below our competition.

But the faculty in CIS are not pessimists; we have grown up in a discipline which changes constantly and we believe in change for the better. Thus, in the section on Strategic Planning, we present a plan to recover from this state of bankruptcy. It takes an investment by the University to make CIS a major thrust of KSU. We want to be a Top 45 department in the country so that we can compete for the increased extramural funding that is predicted to become available from the federal government. Unless we are considered a Top 45, we might as well reverse the trend of the past several years which has seen more than a doubling of extramural funding, increased research productivity by a factor of 4, and improved our computing facilities through extramural grants.

It is time for central administration at KSU to decide if CIS is to be nurtured to enable large payoffs in extramural funding and improved instructional programs. Or, shall we return to the status of 1982, when we were principally a teaching department? We have done remarkably well with extremely low budgets, but we have reached the point of no return in our quest for national stature. We need funding for every aspect of our program. It is time for KSU to do its part. The faculty have done theirs.

II. Instructional Programs

A. Undergraduate Programs

1. Curriculum Development

The Undergraduate Studies Committee is responsible for the health and well-being of all the undergraduate programs - BS/BA in Computer Science and BS/BA in Information Systems. In general, this committee supervises all curricular matters, proposes changes to curricula, interfaces with the College curriculum committee, and interfaces with the Graduate Studies Committee to insure a smooth transition from undergraduate to graduate school.

During the past year the Undergraduate Studies Committee recommended a major restructuring of the CIS 110 and CIS 200/20X courses.

The changes in the CIS 110 course enabled students to have more time in a computer laboratory with an instructor present. The committee recommended that the lecture component be two hours and the third hour be a recitation in a computer laboratory. This would allow actual hands-on experience with instructor assistance and application demonstrations to a smaller group. This change was implemented starting with the fall 1990 semester. Results to date indicate a much improved level of satisfaction and performance with students.

The CIS 200/20X courses were changed to make CIS 200 a three hour course and closely bound to a single teaching language, and to use a graphics approach in teaching the material. Laboratory courses were changed to one hour. The recommendation was made and implemented to require students to take CIS 200 and CIS 203 as a introductory sequence and to use Pascal as the primary teaching language. After completion of the CIS 200/203 courses, the students may then take any of CIS 204 FORTRAN, CIS 206 BASIC, or CIS 208 C. The CIS 204, 206, and 208 language laboratories can be taught at an advanced level, because students should have the common elements of programming from the threshold class. The changes were implemented starting with the fall 1990 semester. Students have indicated a clearer understanding of program design, algorithms, and programming when the lecture is bound to a single language. Because students must take the threshold sequence before taking the BASIC, FORTRAN, or C laboratories, we anticipated a lesser demand for some of those laboratories. Demand for BASIC and FORTRAN have dropped but the demand for C has increased 300%.

The committee reviewed the sequence of theory courses, PHILO 220 Symbolic Logic, MATH 510 Discrete Mathematics, and CIS 570 Theoretical Foundations of Computer Science. Because of the change from CMPSC 370 to CIS 570, some students in that class did not have both PHILO 220 and MATH 510. The committee notified the Department advisors to make efforts to have students take the required prerequisites.

The Undergraduate Studies Committee set the following goals for the school year.

- a. Update the statement of focus and goal for each core course.
- b. Prepare a proposal for NSF Undergraduate Equipment Grant program. Hankley, Campbell (November 1990)
- c. Manage the application for accreditation by Computing Sciences Accreditation Board (CSAB).
- d. Make recommendations for faculty supervision of undergraduate service courses.
- e. On-going review of existing courses and development of new offerings.

The study of focus and goals for the core courses was concentrated on the CIS 200-300-500 sequence. The problem causing the most concern was what language to employ. Discussion revolved around the need for a language using objects, availability of a good compiler, and one that would fit the programming sophistication of the undergraduate population. The decision was made to continue using Turbo Pascal through the spring 1991 semester, and to further evaluate Modula-2 and Ada.

The committee developed some guidelines for the general content of the CIS 200-300-500 sequence. The 200 course

will continue to concentrate on fundamental programming skills, documentation standards, and problem solving skills. The 300 course will introduce common data structures and classes, but students will not be asked to design new abstract data types. The 500 course will require students to analyze alternative data structures, and do considerable analysis of programs for correctness and efficiency.

The committee wrote a proposal for submission to NSF that would create a new course offering. This course would utilize near state-of-the-art computers, software, and networks to lead students from setting up a modern office through utilization of available software packages. The focus would be on the participation of the students in actually doing all the connections, installation of software, scheduling, and similar activities.

The Department has elected to seek accreditation by CSAB for the Computer Science major/BS degree. The first report is due in June 1991 and will require a considerable amount of data collection and consolidation concerning the required courses in the Computer Science major.

A major concern of the Department and the Undergraduate Studies Committee is the quality and continuity of the CIS 110 and CIS 200 service courses. Maarten van Swaay will monitor the CIS 110 class and do development work in the following areas:

- a) plan for continuity in teaching
- b) set up small recitation/lab sections
- c) resolve balance of "tools vs problem solving"
- d) incorporate graphic user interface section

Myron Calhoun will monitor CIS 200, William Hankley CIS 300, and Rodney Howell the CIS 500 course and its relationship to our undergraduate theory courses to insure continuity between instructors and appropriate pace in the class.

The committee did preliminary study on the development of an experimental design course that would have C++ as the primary language. The committee discussed what tools might be appropriate for such a course and what relation the course would have to our present CIS 500 and CIS 540/541 sequence.

Items of a miscellaneous nature of concern were:

- a. Review of present textbooks in CIS 200, CIS 300, and CIS 500.
- b. Coordination with College of Business with our IS curriculum.
- c. Letter to Ad Hoc Committee on Common Univ Degree Requirements.

2. Advising System

The Department currently has two undergraduate advisors, one assigned full-time in the Department and devotes as much time as needed to advising. This arrangement has worked well, due to the reduced number of students in computer science as compared to previous years and to the experience level of the advisors.

Undergraduate advising is concentrated in three different events: early enrollments for on-campus students, early enrollments for new and transfer students, and campus visitations. Early enrollments, which occur in April and November, require a concentrated effort by both advisors. Students are normally scheduled by appointment for a 30 minute advising session. The Department maintains a personal folder on each student and the availability of SIS usually enables the session to be efficient and productive. The majority of the undergraduates schedule an appointment, and most are advised during an intensive three week period just prior to the actual early enrollment period. The full-time advisor schedules an additional four-six nights for evening appointments.

Transfer students have early enrollment at the end of the April on-campus early enrollment period and during the

summer early enrollment. New freshmen can enroll during the summer period. The summer early enrollment is usually the last three weeks in June, and runs from Tuesday through Saturday. Both advisors are available for the summer enrollments and the advising is either done individually or by group, depending on the number attending. One of the advisors is on call for the Saturday sessions - the number attending is usually available by 10 A.M. Transfer students will usually have their transfer courses evaluated, if not the transcript analyst in Arts & Sciences can give a quick response. New freshmen have a limited number of courses from which to choose, the most critical being the level of mathematics at which to begin.

Campus visitations are sometimes scheduled several days in advance, but more commonly the Department receives just a few hours notice. These students are told about the two majors offered in the Department, information about general requirements, and if time permits, given a short tour of the Department computing facilities. Spring is the busiest time for visitations. The Department will have about 5-10 per week during that time. Each visitation takes about 30 minutes, perhaps a little more if parents accompany the student.

The Department also sends individual letters to students in the Department just before the early enrollment periods to remind them about making an advising appointment. We also send letters to high school and transfer students who have applied to Kansas State. The letter is a general welcome and explains the benefits of a major in Computer Science or Information Systems accompanied by our undergraduate requirements brochure.

Department advising includes some counseling for students having academic problems, dropping classes, and any number of events which can happen on short notice. These are generally handled by the full-time advisor. Department advisors also do informal graduation checks if requested by students.

While no formal survey has been done concerning the success of our undergraduate program, it appears to be successful in terms of informal student comments. Students appear satisfied with the availability of appointment times and the quality of the advice. The number of undergraduates is about 275, which allows the advisors to become well acquainted with most of them.

There is another minor area of advising. There are a number of students who want to work on an additional undergraduate major, and many of these would be better served by taking deficiency courses for a masters, then seeking entry in the masters program. The full-time advisor counsels these students as to their most viable options. There are perhaps one of these counseling sessions per week.

There have been no major problems with the advising program, but we need to continue striving to improve retention. A program to track entering student progress needs to be done as part of the retention effort. This follow-up should be accompanied by some form of exit interview, should a student decide to drop out of school. Informal studies now indicate a fairly high level of drops from the program and low grades appear to be the common symptom, but that cannot be definitely stated, nor can the basic cause be defined. This might require assigning a small amount of additional time to the advising component of the Department. This study might provide some insights as to how to advise new students coming into the program and perhaps some valid screening criteria.

3. Accreditation

For four years we have requested the opportunity to have the Computing Sciences Accreditation Board evaluate our BS program in Computer Science. This year, Interim Dean Kaiser approved our request. Thus, in 1991, we will go through the accreditation process.

B. Graduate Programs

1. Curriculum Development

The Graduate Studies Committee is the primary administrative body for the graduate programs in CIS. This committee processes applications, proposes curriculum changes, evaluates graduate student progress, and recommends graduate

students for assistantships. The Graduate Studies Committee is also responsible for administering written preliminary examinations for PhD students and develops guidelines to help graduate students make progress in their coursework and research projects. The current curriculum requirements are listed in Appendices 2 and 3. Guidelines to help PhD students make progress in their research programs are given in Appendix 11.

Planning for the future at KSU, we believe that it is important for the CIS faculty to develop a Master of Software Engineering program. The development of correct and efficient software is essential to the creation of many new engineering and business products. Many of the students in the regular on-campus graduate program will leave KSU and become software engineers. Also, at least 50% of the graduates of the AT&T Summer On Campus program are software engineers. The Graduate Studies Committee is beginning to structure the MSE program using the curriculum developed at the Software Engineering Institute at Carnegie-Mellon as a model. We are also interested in developing a Computer Engineering MS in conjunction with EECE.

The Graduate Studies Committee has been involved in several additional important issues this past year. Specifically the Committee has been discussing new prelim oral guidelines and a possibly new dissertation format. The Committee (after discussing the matter with the faculty) presented to the faculty that we should no longer require an oral as part of the prelim testing; this new prelim procedure was approved by the faculty. The Committee has also discussed whether the department should consider a new dissertation format which would allow a student to have a dissertation consisting of submitted/published papers along with a survey-paper-quality introduction. The Committee's handling of this question was indecisive. Basically, the Committee said that such matters are really in the hands of the individual supervisory committees, but the Committee also noted that some faculty members feel that this (possibly) new procedure is a questionable one.

2. Applications Process

The main activity of the Graduate Studies Committee during this past year has been reviewing applications from students applying to our graduate programs. We continue to see an increase in the number of inquiries and in the number of applications. The Committee have begun a two-step application procedure which allows us to learn about better students sooner and to reject poorer students earlier. However, there are still significant problems in the application process, caused by lack of clerical support for this process.

This past year we processed 785 requests for admission, processed 183 completed applications and admitted 125 graduate students. The quality of these applicants has risen dramatically in the past several years. At present, the average values for GRE verbal, quantitative, and analytical scores are 611, 752, and 698, respectively. The average grade point average of applicants is 3.33. Of those admitted, only 22% (28 of 125) actually enrolled; most of these (74%) were students to whom we offered a GTA. Further, only 50% of the GTA offers we made were accepted. The reason: we do not offer high enough stipends. Even though we raised stipends this past year, we are still 20% below our peers.

We still lose several good applicants because we cannot process them soon enough. For several years we have asked for a classified position in the Department to process applications on a timely basis. We have documented approximately 40 hours per week. Each year it is ignored, even though every other department (that we are aware of) that processes as many applications as CIS has a graduate studies secretary. It seems a shame to reduce the quality of the graduate population because of inequitable administrative treatment.

3. Matriculation of Regular On-Campus Graduate Students

We continue to emphasize our graduate program. The fundamental philosophy is to build a national reputation in graduate education. This builds a strong infrastructure for both research and undergraduate instruction. While we have increased the size and quality of our faculty, the funds available for GTA support from the state has dropped from \$342,000 in FY90 to \$275,000 in FY92. This is a 25% reduction in support for graduate students. We have seen about that same decline in enrollment. This is certainly not in keeping with Theme 1 of KSU's Strategic Planning process. More details on graduate student enrollment and graduation rates are given in Tables 2 and 7, respectively. Our graduate rate has not dropped as precipitously because we run the AT&T Summer On Campus program, which is funded entirely from extramural sources.

4. A National Stature for KSU CIS in Graduate Education

a. History

Since 1980 the CIS Department has offered a Summer On Campus (SOC) program for AT&T computing professionals. Please see Appendix 10 for a brief history of the program. Each year AT&T funds 50-70 employees with background in computing to come to KSU CIS for 5 weeks. During these 5 weeks the student-employees take two graduate level classes, along with on-campus graduate students. In 5 years, assuming the student-employees do acceptable academic work, they receive an M.S. in Computer Science. We have graduated approximately 80 students from this program and it is extremely successful. We are now ready to enhance this program with electronic delivery of graduate level courses via satellite and interactive graphics to all AT&T sites across the country. This will permit the students to attend only 3 summers on campus and receive the rest of the required courses for the MS through video instruction.

b. National Electronic Outreach from the Plains

We wish to contract with National Technological University (NTU) to teach KSU CIS graduate level courses via satellite. AT&T, along with 75 additional major companies in the U.S., is a corporate member of NTU. The company pays NTU a fee for each course taken by an employee. The member universities are then reimbursed for teaching the courses. In turn, the students can get either NTU credit or credit at the offering university. Our proposal is to provide regular graduate level courses through NTU and enable AT&T SOC students to finish their M.S. degrees in 3 summers on campus and two academic years taking NTU courses offered by KSU CIS. Lionel Baldwin, President of NTU, and Bob Sicora, AT&T Corporate Education Center, both support this move.

Once we have established our credibility through NTU, employees at other major corporations can take our courses. This will establish a national prominence for KSU in the major corporations of America. Through this mechanism, any company which has a downlink and is a member of NTU can receive the courses. Ultimately, this may be the right link into the metropolitan areas around Kansas City and Wichita. For example, Allied-Signal Aerospace in Kansas City, AT&T in Kansas City, Boeing in Wichita, NCR in Wichita, and BDM in Leavenworth can downlink these courses. (They are listed in NTUs brochure as being corporate members. There are currently approximately 75 corporate members, including highly influential and respected corporations such as IBM, BELLCORE, General Dynamics, Hewlett-Packard NASA, Eastman Kodak, etc.)

c. Cost Analysis

The total cost to companies is \$405 per credit hour. NTU provides marketing, pays for satellite time and collects tuition. NTU then returns \$231 per credit hour back to the originating department. If we provide 2 courses per semester with an average enrollment of 25 in each course, we will generate \$69,300 per year. Out of this amount, we must pay studio costs for the classroom. I would hope to use the remainder of the proceeds to fund faculty development awards for those faculty members contributing to this program. NTU is moving to compressed video for broadcast. This would reduce the per credit cost and make the program more attractive to companies.

d. University Impact

Once we have established a CIS presence in these corporations, other departments will certainly be interested in providing such instruction. The ultimate impact is that KSU will have a presence within some of the most influential corporations in America. Grants, gifts, influence, and partnerships are much more likely by leveraging this sort of electronic delivery of graduate level courses to help upgrade the technological and scientific expertise of our nation's corporations.

III. Faculty

A. Faculty Composition

The makeup of the faculty is reflective of the two major forces on this department; we work in a young discipline and we are underfunded. We are principally a young faculty with a predominance of assistant professors. We hired two new faculty members this past year, Dr. Olivier Danvy and Dr. Jan Chomicki. This brings our total to 15 faculty members. We still have not reached a critical mass of faculty working in any specific area. Without this critical mass, we cannot be competitive for "big science" grants, nor can we participate in any meaningful way to solving the "grand challenges". We still need at least another eight faculty members whose area of expertise is in one of the following five areas: computational engineering and science, software engineering, programming languages, parallel and distributed systems, and knowledge and data base engineering. In the section on Strategic Planning we carefully enumerate the requisite resources to become a Top 45 department in computing and information sciences.

Because the University has been willing to pay a competitive wage for new PhDs, but unwilling to allocate funds to upgrade the salaries of senior faculty, we are in a severe salary compression situation. At present, full professors earn 25% less than their peers at other Computer Science PhD granting institutions. Associate professors are paid 15% less than their peers. Assistant Professors are within 6% of their peers. One of the fundamental problems at KSU is the unwillingness to compete at the senior faculty levels. It diminishes the instructional and research quality of the entire university and it substantially reduces the capacity of this institution to acquire extramural funding.

B. Faculty Activities

The average faculty member in this department is quite productive. To give an indication of this productivity, an average faculty member:

1. published (or had accepted for publication) 3.5 articles and submitted an additional 3.7 articles,
2. wrote 1.5 proposals for extramural funding (resulting in a department total of approximately \$400,000 of extramural funding, 30% of the total department budget),
3. taught 3.1 classes (with an average TEVAL score of 3.7 at the 300/400/500 level, 3.61 at the 600/700 level and 4.0 at the 800/900 level),
4. was major professor for 5 graduate students,
5. served on 2.5 departmental and university committees, and
6. was involved with at least 20 other activities such as prelim development and grading, reviews for outside agencies, talks at other universities, professional society service, supervision of GTAs, facilities acquisition, participation in readings classes, guiding graduate student seminars and projects, membership on supervisory committees, advising student groups, advising students, etc.

Details on faculty activity are contained in appendices 4, 5, 6, 7, 8, and 9. In these appendices we have enumerated faculty contributions in research, committee service, grantsmanship, teaching, and professional service.

IV. Research

A. General Research Areas

Research activities in this department are broadly categorized into the following general areas: programming

languages, software engineering, data base systems, computational engineering and science, computing ethics, and distributed and parallel systems. Appendix 8 contains more detail on each research project.

Programming Languages

Dr. David Schmidt works in the area of programming language semantics. He is currently working with Susan Even on action semantics, which is a high level, readable, beginner's notation for defining semantics of programming languages. He is working with Masaaki Mizuno on a denotational semantics-based correctness proof of security flow control algorithms. He is working with Kyung-Goo Doh on "well-formed" programming languages in the areas of static typing, binding in block-structured languages, and block-structuredness of storage cells. Adrian fiech is a student working with Schmidt in action semantics so that this model can describe polymorphic programming languages like ML. Karoline Malmkjaer is working in a related area to Schmidt. She is working on defining methods for analyzing partial evaluator programs. Dr. Olivier Danvy is working with Banerjee to design an orthogonal Algol-like programming language. Dr. Danvy also works on improving the effectiveness and efficiency of partial evaluation with Charles Consel of Yale University, on models of control with Andrezej Filinski of Carnegie-Mellon, and on the essence of partial evaluation with Karline Malmkjaer. Dr. Austin Melton is working on understanding and developing categorical programming languages and on understanding data types via a categorical construction called dialgebras with Hans Dybjkjaer of DIKU. He is working with Bill Young on programming languages. He is working with Dr. George Strecker and Bernd Schroeder, from Mathematics on Lagois connections properties in applications of computer science. Dr. Jan Chomicki works in the area of logic programming.

Software Engineering

Dr. William Hankley works in the area of temporal specifications for software systems and in the general areas of specification and verification. Dr. Melton is working on developing constructive software measurement with the hopes of producing a major re-evaluation in how software metrics are designed and tested. Dr. David Gustafson is working in the areas of software measures, formal ways of comparing software testing methods, formal models of software development (with Eric Byrne), and software reliability (with Dr. Sallie Keller-McNulty in Statistics).

Data Base Systems

Dr. Elizabeth Unger works in the areas of Data Security and Integrity with Sallie McNulty and Lien Harn (from UMKC). Dr. Austin Melton is working with Dr. Unger and Dennis Ng on complex data objects. He is also working with Dr. Sujeet Shenoj of Tulsa University on a generalized database model called the equivalence-class (partition) relational database model. Dr. Jan Chomicki works in the area of deductive data bases, novel query languages, query processing methods, and finite representation of infinite query answers; he also works in the area of database integrity with emphasis on transition constraints, temporal logic active databases, and triggers. Dr. Zamfir-Bleyberg is working on object-oriented databases.

Parallel and Distributed Systems

Dr. Rodney Howell is working in the area of hard real-time scheduling. He also works in the area of problems associated with petri nets. Dr. Hankley is working on temporal specification of Ada semantics. Dr. Unger is working with Dr. McNulty on active data elements. Dr. Mizuno is working on secure information flow in distributed systems (with Schmidt), recovery in distributed systems, and distributed mutual exclusion algorithms (with Mitch Nielsen). Dr. Unger is working on office information systems. Dr. Zamfir-Bleyberg is developing an entity-relationship algebra, a formal model of concurrency. Dr. Ravindran is developing high performance algorithms for ISDN switches and fault-tolerant remote procedure calls. Finally, Dr. Wallentine is working in the area of parallel discrete event simulation. He is working with Jim Butler on a time-space parallel discrete event simulation language model with applications to more general parallel applications, with YuFeng Li on simulators of parallel discrete event simulators, and with Al Briner on temporal locality in hybrid models of conservative and optimistic parallel discrete event simulators.

Computational Engineering and Science

Dr. Maria Zamfir-Bleyberg is working with Dr. Isenhour in Chemistry to apply artificial intelligence and concurrency control mechanisms to control of analytical chemistry robots. Dr. Rodney Howell is working with P. Krishnaswami from mechanical engineering and George Strecker from math in the area of process planning for machine shops. Dr. Zamfir-Bleyberg is also working on the application of neural networks for the detection and classification of various grain features, with Inna Zayas, USDA Grain Marketing Research Laboratory.

Computing Ethics

Dr. Maarten Van Swaay works in the area of computing ethics. He has published several papers on the responsibility computer scientists must exercise in developing software which is correct, efficient, and effective. Furthermore, he writes about where computing ethics guidelines can or cannot be applied, and where the rules stop and judgement begins.

Extramural Funding

In this past year we have had more than \$200,000 in research and educational funding active within the department. Additionally, we have written four equipment grant proposals, 17 research and development grant proposals, and one Presidential Young Investigator proposal. Appendix 7 contains details about our grantsmanship activities. We expect to improve on this area in the next several years, but only if we have a larger faculty so that we can cover both research and teaching duties.

B. Seminar Series

It is essential that research be conducted within the context and knowledge base of our global village. Thus, we have a seminar series which attempts to bring to the plains (KSU) distinguished speakers who can appraise us of the state of our discipline worldwide. A listing of these speakers is presented here.

The department seminar series was very active in the past year. We had a wide variety of speakers.

Our first speaker of the Spring 1990 semester was Guo Qiang Zhang from the Computer Science Department at the University of Georgia. He spoke on February 1 on "Mu-Calculus of Domain Logic."

On February 20, Dr. James Tomayko from the Software Engineering Institute at Carnegie-Mellon spoke about "NASA's Manned Spacecraft Computers."

Dr. K. Ravindran, a KSU assistant professor, described "A Flexible Communication for Distributed Applications" on March 1.

Dr. Vasant Shambhogue, from Cornell University, spoke to us on March 27 on "The Expressiveness of Indeterminate Dataflow Primitives."

On March 29, Dr. Rao Vempaty from the University of Texas at Austin gave a seminar on the topic of "Efficient Parallel Algorithms for State-Space Search."

Dr. Tsung Kuo from SUNY at Stony Brook presented a seminar on "Lazy Functional Programming and Strictness Analysis" on April 2.

Our next speaker was Dr. William Winsborough, from the University of Chicago. His talk was presented on April 3 and entitled "Analysis of Shared Data Structures in Logi Programs for Copy Avoidance."

Dr. Jan Chomicki, University of North Carolina at Chapel Hill, presented the next seminar on April 6, entitled "Finite Representation of Infinite Query Answers."

Dr. Olivier Danvy, KSU visiting professor, presented a seminar on April 9 entitled "The Abstraction and Instantiation of String Matching Programs" and presented a second seminar on April 26 on "Abstracting Control."

One of our PhD graduate students, Richard Courtney, presented a seminar on May 1 entitled "A Formalism for Transformations of Hierarchy Diagrams."

The last seminar of the Spring semester was presented by Dr. Michael Wick of Washington State University. His seminar, on May 11 was entitled "Reconstructive Expert System Explanation."

We had only one seminar speaker in the Summer of 1990. Dr. Christof Ebert, University of Stuttgart, presented a seminar entitled "Visualization Techniques for Analyzing and Measuring Design Decisions" on July 25.

Our first speaker of the fall semester 1990 was Dr. Charles Consel from Yale University. His talk on Thursday, September 27th, was titled "Semantics-Directed Generation of a Prolog Compiler".

The next talk was titled, "Non-Standard Clustering Algorithms" and was given on Wednesday, October 3, 1990 by Dr. James C. Bezdek, who is the Nystul Professor of Computer Science at the University of West Florida.

The third talk was given by Susan Even, a PhD Candidate in the department on the topic, "Type Inference for Action Semantics" on Thursday, October 25, 1990.

Dr. Andrzej Filinski of the School of Computer Science at Carnegie-Mellon University talked on "Declarative Continuities and Categorical Duality" on November 2, 1990.

On November 14th, Dr. Radia Perlman of Digital Equipment Corporation talked on "Calculating a Safe Route in a Computer Network Despite Traitorous Advisors".

Dr. Andrzej Ciepielewski of the University of Iowa, Iowa City presented "Parallel Implementations of Prolog: How to Map Dynamic Trees To Multiple Processors Tuesday, November 20.

The last talk in 1990 was presented by our own faculty member, Dr. Olivier Danvy, who talked on "Partial Evaluation in Parallel" on November 29th.

V. Computing Infrastructure

A. Current Environment

Essential to all scientific and engineering disciplines are the tools which promote progress in research, development, and instruction. In Computing and Information Sciences, it is essential that students have state of the art software and hardware laboratories. This is a rapidly evolving technology and lab work on obsolete equipment is nearly useless. Our research paradigms include theory, where we prove theorems about computing objects, engineering, where we design and validate the operation of real computing systems, and experimentation, where we experiment with models of computing and communications systems to test both correctness and efficiency. Our research and instructional capabilities are directly related to the quality of our computing infrastructure - facilities, maintenance, and personnel.

Our present environment consists of approximately 90% obsolete equipment. Table 6 contains a detailed listing of the computing facilities in the Department and Figure V.1. contains a pictorial representation of the equipment and its internetworking. We have approximately 100 PCs, 15 minicomputers, 4 mainframes, 1 mini-supercomputer, 50 terminals, 15 X-terminals, 15 workstations, 300 software packages, and 5 networks. This sounds impressive until you realize that most of this equipment is obsolete. Furthermore, much of the equipment is not operational. At present, it would

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