University of Washington
COMPUTER SCIENCE GROUP

DEVELOPMENT OF THE GRADUATE PROGRAM IN COMPUTER SCIENCE AT THE UNIVERSITY OF WASHINGTON

A Proposal Submitted
to
The National Science Foundation
by
Jerre D. Noe
Professor and Chairman of Computer Science

Seattle, Washington
1970

BOARD OF REGENTS
University of Washington
Seattle, Washington 98105

TO: NATIONAL SCIENCE FOUNDATION

TYPE OF SUPPORT REQUESTED: Departmental Development Grant

TITLE OF PROJECT: Development of the Graduate Program in Computer Science at the University of Washington

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AMOUNT REQUESTED: $584,235.00

DESIRED GRANT PERIOD: July 1, 1970 through June 30, 1974

UNIVERSITY OFFICIAL TO BE CONTACTED REGARDING GRANT OR CONTRACT NEGOTIATIONS:
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Date of Proposal: 19 January 1970

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OUTLINE OF PROPOSAL

I. PURPOSE OF PROPOSAL

This proposal requests funds that will allow acceleration of the development of the computer science program at the University of Washington at a rate greater than that which is possible within the resources of the University alone. The significant effect of this acceleration will be on the nature of the program, not just its rate of growth. Specifically, it is expected to provide growth opportunity in theoretical areas in addition to applied areas. The reasons for this, and the basis for belief in the importance of such balanced development, are contained in the proposal.

In general, the proposed acceleration will allow greater development and productivity of the existing faculty; it will provide for earlier addition of new faculty. It will not expand the ultimate size of the activity beyond that which is already planned. In particular, the number of faculty at the end of the requested funding period will be no greater than currently planned. However, the requested funds will allow development in breadth during the most formative years and will make it possible to arrive at the planned state with greater momentum. This in turn will enable the University to contribute sooner and more fully to the preparation of high-trained individuals for the computer science field.

II. SUMMARY

This proposal requests a grant of $584,235.00 over a basic period of three years with an extension to a fourth year in one category. The purpose of the requested grant is to augment a variety of facets of the development of the computer science activity at the University of Washington. The proposal describes the brief history, current status, and long-term plans of the Computer Science Group and describes the several ways in which the University has provided money, space, and materials for development of an acitivity of the highest quality. The general reasons that additional funds would be helpful to the development are described, as are the particular categories of use to which the funds would be applied. The approximate amount of money that would be devoted to each category is indicated and the total budget is calculated with no allowance for indirect costs, in accordance with National Science Foundation policy to provide only direct funding for supplemental development grants. A statement of the relative priorities that we attach to the various categories is included.

III. BACKGROUND

A. THE UNIVERSITY OF WASHINGTON

The University of Washington was founded in 1861. Like other frontier "universities," the new institution's rude beginnings gave little promise of the academic stature its founders hoped it would achieve. The first class contained only one college-level student, and it was not until 1876 that the "University" awarded a Bachelor's Degree. In fact, for forty years after its opening, the University assumed some responsibility for the pre-college training of the youth in its area.

The University of Washington's educational objectives were legally defined by the State Legislature in 1909 when it said:

> "The aim and purpose of the University of Washington shall be to provide for the students of both sexes, on equal terms, a liberal instruction in different branches of literature, science, art, law, medicine, military science, and such other departments of instruction as may be established from time to time by the Board of Regents."

Over the years, these goals have been construed to include providing a general education in the broadest sense for all students who enroll; giving instruction in the humanities and in the pure and applied natural and social sciences, and preparing students for professional practice in the fields for which the University has been assigned responsibility in the State of Washington; conducting research and promoting the advancement of knowledge; providing special continuation and extensive education, and serving the citizens of the State of Washington in auxiliary ways in harmony with the major scholastic objectives.

The University's development and its goals have been formed over the years to meet its own internal needs and those of the changing educational environments in the community and nation. The University is now one of the six publicly-supported four-year institutions of higher learning in the state. The others

are Washington State University at Pullman, and four state colleges: Eastern Washington at Cheney, Central Washington at Ellensburg, Western Washington at Bellingham, and the new Evergreen College at Olympia. The pressures of ever-increasing enrollments since the Second World War have encouraged the development of statewide approaches to the problems of higher education to insure the most efficient utilization of the state's educational resources.

Over the years, the public colleges and universities in Washington have understood the importance of the intercommunication and coordination. A system of informal meetings between presidents of these five (now six) institutions became, in 1960, a formal organization, Council of Presidents, which meets at least four times a year and frequently more often to discuss mutual problems and aspirations. The public colleges and universities have agreed that proposals for new or continuing graduate degree programs will be transmitted to each for review by appropriate faculty members, and comments will be transmitted to the proposing institutions.

The University's emerging role, the result of the changing environment and the growing cooperation among the public institutions of higher education, has been defined and elaborated in two statements: the first on The Role of the University of Washington, adopted by the Board of Regents in 1960; and the second on The Plan for Higher Education in Washington, adopted by the Council of Presidents in 1964. The first defined certain aspects of the institutional roles, particularly with respect to community colleges. The second urged continued and intensified support for community colleges and the immediate establishment of the new Evergreen College. It also recommended that the two universities aim toward an enrollment of forty per cent underclassmen and sixty per cent upperclassmen and candidates for Master's, Doctor's, and professional degrees.

Even before the Council of Presidents statement, the University of Washington enrollment trends reflected an increasing emphasis on upperclass, graduate, and professional education. Underclass enrollment was 46.2% of the student body in 1963. By autumn 1968, underclass enrollment had dropped to 38.4%. During the

same period, total enrollment rose from 7,368 to 31,913. Graduate enrollment has grown from 521 in 1930 to 6,106 in 1968.

Enrollment figures are only one indication of the University's longstanding commitment to the development of an outstanding graduate program. Though its resources in 1885 were meager and it was still burdened with maintaining a college preparatory program, the University was able in that year to grant its first Master's Degree. In 1911, the Graduate School was established to administer the expanding graduate studies program. Today the graduate faculty comprises 57% of the total University faculty and 88% of the faculty at the rank of professor.

The challenges of the past decade, especially the rapid rise in enrollment, have strained the resources available to the University for the achievement of a broader range of excellence. The State Legislature has been, and continues to be, sympathetic and generous in its support of the University. The voters and taxpayers have demonstrated a strong appreciation of the needs of higher education. In 1965-66, for example, the state tax cost per citizen for operating expenses of higher education was $31.66 in Washington, according to a study conducted for the Western Interstate Commission for Higher Education. The average per capita tax cost for the fifty states was $15.65, and for the thirteen western states it was $23.36.

1. Interdisciplinary Programs

A significant portion of the University's planning does not originate at the departmental level. The rapid accumulation of new knowledge in the recent past has led to study and research which cross the boundaries of traditional disciplines. Frequently, the development of an interdisciplinary approach calls for new equipment, new facilities, and men with new or multidisciplinary training. These interdisciplinary efforts may evolve into new disciplines broader than the traditional ones, or into more narrowly circumscribed fields of knowledge at a particular interface between traditional disciplines.

There exists a strong view that the University's academic activities should remain on one campus, to the extent possible, in order to encourage interaction between disciplines. This is a great aid to implementation of programs that cross traditional boundaries.

At the University, interdisciplinary challenges have generally resulted in the formation of a study group either within a college containing the disciplines involved, or perhaps under the Graduate School when more than one college or division of the University is involved. The President may also appoint study groups or committees to examine University strengths and weaknesses in areas which, while being within a single discipline, touch upon several colleges or divisions.

Where the interdisciplinary approach leads beyond the scope of a study group, several formal paths are possible: a new department may be formed, encompassing areas of interest; an administrative organization may be created to conduct research or develop and carry out a program of studies leading to degrees; or a study group may take on additional responsibilities necessary to conduct programs of study or to support research or training in the critical departments.

The Computer Science Group is the result of having followed such an evolutionary path, and it now has degree-granting authority, budgets, facilities, and personnel. A brief summary of its history and present status is presented in the next section.

B. COMPUTER SCIENCE AT THE UNIVERSITY OF WASHINGTON

During the summer of 1965, Dean Joseph L. McCarthy of the Graduate School established a Committee on Computer Science with Professor Allen Goldstein as chairman. After intensive study of the growth of the computer science field and of the needs and the potential at the University of Washington, this committee recommended that an interdisciplinary group be established with the Graduate School and that it be allocated faculty positions, funds for operation and for secretarial service, and space. While Dr. Goldstein was on leave during 1966 and 1967, Dr. Robert Ritchie was appointed as chairman of the committee. The committee continued preparation of detailed plans and met with a number of experts in the field of computer science, including Mr. Julian Bigelow of the Institute for Advanced Study, Professor William Miller of the Computer Science Department at Stanford University, Professor Marvin Minsky of the Electrical Engineering Department at Massachusetts Institute of Technology, Professor A. Oettinger of Harvard University, Professor Ottis Rechard of the Computer Science Department at Washington State University, Professor J. A. Robinson of the Computer Science and Philosophy Departments at Rice University, and Professor L. Zadeh, Chairman of the Electrical Engineering Department at the University of California, Berkeley. Representatives of the committee made on-site visits to Cornell University, Carnegie Institute of Technology, New York University, and the University of California at Berkeley.

In July 1966, a formal application for graduate degree programs in computer science was submitted to the University of Washington. This recommended degree programs for Master of Science and Doctor of Philosophy in Computer Science, outlined the qualifications for admission, established a course list, and contained the curricular vitae of faculty members currently on campus who were willing and able to support the program. After being examined and approved from an academic, administrative, and budgetary viewpoint, the application was submitted to the Regents of the University and received formal approval from that body in March 1967.

The first students were admitted during the fall quarter of 1967, and nineteen students were enrolled during the 1967-68 academic year. These were selected from 77 formal applications resulting from 300 inquiries. During the academic year 1968-69, the enrollment increased to thirty-two, with the new admissions selected from 220 letters of inquiry that resulted in 76 formal applications. For the year 1969-70, 99 formal applications were submitted from about 280 letters of inquiry and fifteen new students were enrolled, giving a total enrollment of 44. A more complete analysis of the types and numbers of students who have applied for admission to the program will be found in Table 1. Degrees which have been granted by Computer Science to date include two Ph.D. and nine M.S. degrees. The faculty, in addition to those who helped bring the program into being, was augmented during the winter and spring quarters of 1968 by the appointment of Dr. Carl-Erik Fröberg of the University of Lund, Sweden, as a visiting professor. In the summer of 1968, Dr. J. D. Noe was hired as chairman of the Computer Science Group, and during the following academic year some faculty members transferred part-time to the group. Another full-time faculty member, Dr. J. L. Baer, assistant professor, was added to the Computer Science Group at the beginning of fall quarter, 1969.

The Computer Science program, as offered during the academic year 1969-70, is summarized in Appendix B.

At the beginning of the autumn quarter of 1969, seventeen faculty members were associated with Computer Science. These ranged from full-time appointments to liaison activities. Based on their contributions to teaching of Computer Science-related courses, supervision of theses, and participation in planning and executing the activities of the group, the combined efforts of these seventeen faculty members are approximately equal to five full-time equivalents. The curricular vitae of these faculty members are included in Appendix A.

In November 1967, the Ad Hoc Computing Facilities Committee of the Computer Science Group recommended that a computer be dedicated to use by the Computer Science faculty and students as an integral part of the teaching and research

APPLICANT ANALYSIS (Revised 23 December 1969)

Table 1

		TOTAL	PRIOR WORK: Engineering	PRIOR WORK: Mathematics	PRIOR WORK: Other	DEGREE SOUGHT: MS	DEGREE SOUGHT: PhD	AVERAGE GPA BEFORE APPLYING: Undergraduate	AVERAGE GPA BEFORE APPLYING: Graduate	ENTERING FIRST** GRADUATE YEAR: Baccalaureate Elsewhere	ENTERING FIRST** GRADUATE YEAR: Baccalaureate from U of W	CONTINUING UW** GRAD STUDENTS: With UW Grad Degree from Other Dept	CONTINUING UW** GRAD STUDENTS: No UW Grad Degree
Applicants* 1967-68	77	17	48	12	48	29	2.90	3.30	16	6	24	10	
		22%	62%	16%	62%	38%			21%	8%	31%	13%	
Applicants* 1968-69	76	14	50	12	50	26	3.08	3.48	22	10	19	3	
		18%	66%	16%	66%	34%			29%	13%	25%	4%	
Applicants* 1969-70***	99	22	65	12	57	42	2.99	3.37	54	4	15	5	
		22%	66%	12%	58%	42%			55%	4%	15%	5%	
70-71	117												
Admitted 1967-68	23	2	18	3	9	14	3.10	3.58	1	1	13	6	
		9%	78%	13%	39%	61%			4%	4%	57%	26%	
Admitted 1968-69	24	5	18	1	14	10	3.34	3.55	3	4	14	1	
		21%	75%	4%	58%	42%			13%	17%	58%	4%	
Admitted 1969-70	24	1	20	3	6	18	3.27	3.62	12	1	5	3	
		4%	83%	13%	25%	75%			50%	4%	21%	13%	
70-71	22												
Enrolled 1967-68	19	1	16	2	8	11	3.08	3.63	1	0	13	4	
		5%	84%	11%	42%	58%			5%		68%	21%	
Enrolled 1968-69	19	4	14	1	11	8	3.28	3.61	1	4	10	2	
		21%	74%	5%	58%	42%			5%	21%	53%	11%	
Enrolled 1969-70	15	1	11	3	3	12	3.23	3.60	5	1	5	2	
		7%	73%	20%	20%	80%			33%	7%	33%	13%	

* The number of inquiries was 3 to 4 times greater than the formal applications.

** These four columns may not add up to 100% because they do not include students with first-year graduate work elsewhere.

*** To 10-1-69

program. Implementation of this plan proceeded during the 1968-69 academic year. Dr. Earl Hunt was appointed as faculty director of the facility. Computer proposals were requested and evaluated; and, upon approval of the Administration, the Xerox Data Systems Sigma-5 was ordered, and the equipment is now installed and operating. Appendix D summarizes the Computer Science Laboratory in which this machine is the principal facility. It describes the configuration, the organization of the facility, and its relationship to the Computer Center and to the other departments at the University.

Acquisition of this computer gives the University of Washington a great advantage in its efforts to develop an outstanding computer science activity. The "hands-on" experience that this machine provides for students is an important adjunct to their theoretical training.

The University has demonstrated its interest in computer science by spending, or committing, a significant amount of money from its normal funds. This includes approximately $450,000 for facilities alone, counting the Sigma-5 computer, its associated equipment, and preparation of the physical space in which it is housed. The academic budget is in addition to this amount. A less visible portion of the academic support, but nonetheless real and important, has come through the budgets of the College of Arts and Sciences, College of Engineering, and School of Medicine. Faculty in various departments within these entities have been responsible for the development of the Computer Science Group while being financed through the budgets of their home departments. Furthermore, computer-oriented research grants administered within these departments have supported graduate students in Computer Science.

IV. PLANS FOR COMPUTER SCIENCE

A. GUIDELINES FOR PLANNING

Sound growth and development of any enterprise must be based upon philosophical guidelines that can withstand critical examination and that have meaning to those who are concerned. These guidelines serve as the basis for generating specific plans, and they also serve as filters, or judgment criteria, in evaluating any proposed change in plans. The principal views upon which our plans are based are put forth in the following paragraphs:

Foremost is the drive for the highest quality in all aspects of the program. Selection of faculty, students, curriculum, and research topics are areas in which to exercise this view, as are the execution phases of course development and presentation, research, examination, and faculty advancement.

Another of the guidelines is the awareness that computer science, even though it is developing as a unique field, must remain an interdisciplinary activity. This is not to say that it should not have a central group of faculty devoted completely to computer science. Such a core is essential in order to develop an activity with strength. However, computer science must maintain active contact with other disciplines and other departments; one very effective way of doing this is to continue joint faculty appointments. Computer science cannot develop in a vacuum. The applications of computers, and the techniques and theory important in their design and use, touch so many aspects of society and scientific understanding that it seems entirely inappropriate to attempt to have computer science develop without interaction. We expect this to remain true as far as we can see into the future.

A third guideline calls for maintaining a balance in our activities, and this balance is needed along several dimensions. We need to maintain a mix of theory and application, of hardware and software, of influence from Mathematics and Electrical Engineering. What does "balanced" mean? How much of each should one

have? The answer lies in having enough of the relevant activities to benefit from the interaction between them. One institution should not, and in fact cannot, cover all aspects of the computer science field with equal intensity. However, an institution can expect to develop skills within the major entities and foster interaction between them. That is one of the important viewpoints in the development at the University of Washington.

Large size is not a goal in development of the Computer Science Group. It is important to grow reasonably quickly to a threshold of activity that creates the opportunities and excitement needed by both students and faculty, but even this growth must be in response to demand and should take place only if quality can be maintained.

Another guidng viewpoint is the belief that Computer Science at the University of Washington should remain a program for graduate students for a period long enough to establish character and quality. This is closely related to the determination to prevent growth from having adverse effects. We need a period of time for the graduate teaching and research to develop in accordance with the standards of quality we invision. In the opinion of the Computer Science faculty, it would be very damaging to the long-term aims to be forced to cope with the problems of developing and maintaining an undergraduate program within such a large university prior to having established a firm foundation in the graduate studies. However, we recognize the long-term importance of meeting the demand for undergraduate education in computer science. Planning and study to see how we might best help meet this need will occupy a significant portion of our thoughts as we look beyond the graduate program development outlined in this proposal.

B. CURRENT AND EVOLVING PLANS FOR COMPUTER SCIENCE

Within the general guidelines outlined in the section above, plans now exist and are under further development in the areas of increasing faculty, student enrollment, curriculum, research facilities, and physical space.

1. Students and Faculty

Studies have been made by others at a national level that have led to the conclusion that the supply of capable students interested in computer science exceeds the resources available to take care of them. Our own studies in the Northwest area have led us to the conclusion that the same pattern prevails. We feel that our area of responsibility lies not in accepting as large a number of these students as we possibly can, but rather to restrict growth to a rate that will allow us to develop and maintain a program of high quality. On the other hand, development of a vigorous program requires growth to a level that provides excitement and stimulus from the interaction of a number of students and faculty. Furthermore, the minimum rate of growth has a bearing on the nature of the program as well as its quality.

Specifically in our case, we are faced with the following situation: The University of Washington has provided a research facility that in our opinion is exceptionally good. (A description of it will be found later in the proposal.) The use of this facility provides not only a wide range of opportunities, but also causes us to give immediate and high priority to the addition of faculty and students who can make the most of such a facility. This is based upon the simple maxim that we should build in an area of great potential strength, and solidify it before diverting our resources to other areas. But this leads directly to a possible danger. If the build-up around the Sigma-5 in the Computer Science Laboratory consumes most of our available resources, we will miss the opportunity in the Computer Science Group's formative stages to also build in theoretical areas; and we may lose the opportunity to establish and maintain a balance that can be very important to the type and quality of trained individuals produced by our program. We consider the most important aspect of this

proposal to be those items that allow simultaneous build-up in theoretical as well as applied areas during the next few years of our existence.

These considerations have led to a plan for addition of students and faculty that is summarized in Table 2. To the best of our ability to judge, this level of growth represents a plan that will allow the graduate program in computer science to reach a threshold of viability that will provide significant strength in both applied and theoretical work.

2. Curriculum Expansion

The present phase of curriculum development within the program is one of modification of the pattern selected at the outset. New courses are being developed to fill gaps in the curriculum, e.g., one on data structures; another on measurements within computer systems (including some simulation). The faculty members are also considering inclusion of currently available courses in statistics and stochastic processes in the list of those for which computer science credit will be given. At the same time these new offerings are being examined, we are correlating and condensing existing courses to eliminate non-useful overlaps. For example, our offerings in software systems are now being carefully re-examined as are the offerings in automata theory and mathematical linguistics.

The next important phase in curriculum development is now in the stage of preliminary thought. This calls for re-examination of the general nature and structure of our graduate program. The driving forces for such a re-examination arise both from the changing nature of the computer field and from the evolution of computer science education throughout the nation. Specifically, the growth of undergraduate training in computer science leads to greater variation in the state of preparedness of students coming into this graduate program from other universities. Correspondingly, there is a need for undergraduate courses at the University of Washington so that students are prepared for graduate study in the field. This will undoubtedly lead us to yet a third phase, i.e., the development of a formal undergraduate program at the University of Washington. Regardless of whether this finally takes the form of a separate undergraduate

TABLE 2

1970-1974 PLANNING BASIS: STUDENT AND FACULTY ADDITIONS

	1970-71	1971-72	1972-73	1973-74
Students	55	65	75	80
Cumulative Faculty Level Above Present Base*	2	4	5	6
	6.5	8.5	9.5	10.5
Incremental Addition to Computer Science Each Year	2	2	1	1

*Present base equals 4½ positions authorized in Computer Science (one currently open) plus estimated 1-3/4 equivalent positions supplemented by other departments.

program or the form of offerings within the Mathematics, Electrical Engineering, and other departments, it is important that the graduate Computer Science faculty contribute actively to its planning and implementation.

3. Research Facilities

The Computer Science Group at the University of Washington is particularly fortunate in having excellent facilities for research in the field. The equipment in the University's Computer Center and in the Computer Science Laboratory provides a variety of machines and a variety of types of experience, including "hands-on" experience with the Sigma-5. These installations are described more fully in Appendices C and D. Currently the research facility planning calls for some hardware addition, e.g. additional core, increased disk storage, and additional graphic terminals. However, the principal plans involve software development to make the most of the equipment that is available.

4. Plans for Physical Space

Computer Science is now housed in several separate locations in space borrowed from other departments. A careful study of Computer Science Group space requirements, along with requirements of other affected departments, has been completed by an interdisciplinary committee. This study, summarized in the report of the "Ad Hoc Programming Committee for an Addition and Alterations to Roberts Hall" submitted to the University administration in July, 1968, provides for Computer Science to be housed in the space now occupied by the Computer Center. Money has been allocated for the new Computer Center building. Architects are now working on the plans, and it is expected that the space will be ready for occupancy in Fall Quarter 1972 -- thus making integrated space available for Computer Science.

V. GENERAL NEED FOR PROPOSED FUNDS

The University of Washington clearly is interested in computer science and in the development of a very strong activity in the field. This interest has been demonstrated by allocation of funds and space for faculty and graduate students and by acquisition of a significant computer system, the XDS Sigma-5, dedicated to research and teaching in Computer Science. Why, then, is there a request to the National Science Foundation for additional funds for development of this activity?

A basic reason, of course, is that there are many demands on the resources of the University of Washington. Its established programs, its fledgling enterprises, and its new responsibilities that emerge as the social and scientific environment evolves, all conspire to strain the capabilities of the University. It is not easy to make a decision to entirely forego a start in one important field in order to fully develop another. Hence the chronic situation, by no means unique to this particular university, in which many worthwhile programs are slightly starved.

More specifically, we are requesting funds because we are determined to build the Computer Science Group in a balanced manner that provides peaks of excellence in theoretical as well as applied work. This is not an attempt to cover all aspects of computer science equally; this is a task that we believe would lead to mediocrity across the board. It is, on the other hand, a conscious attempt to develop an environment in which students are aware of the breadth of activity in computer science and have an opportunity to participate in at least one strong element of the activity -- be it theoretical or applied; mathematical or engineering; hardware of software. While students are pursuing specialties, the existence around them of the other activities will, we believe, make them not only aware of the interdependence of specialists in various aspects of the field, but also give them some practice in communicating across lines of specialization; in recognizing the need for help from others, and in seeking it out. This, we believe, is an essential feature in the computer science field

and, unfortunately, one that has received too little emphasis in the past. The penalty of such a decision, of course, arises from the fact that it is essential to build simultaneously in more than one part of the spectrum of activities. Specifically, addition of the Sigma-5 computer clearly provides a significant boost to the machine-oriented activities. This will not only attract faculty and students who are interested in that direction; it will also demand considerable attention and a large proportion of our resources in order to develop the software that will turn the facility into that which is required for research and teaching in computer science. While this is proceeding, it is extremely important to build our activities in the theoretical aspects of the field -- for example, in abstract formal languages and automata. If these are not built simultaneously, the group could easily polarize toward one or the other activity to the extent that it becomes impossible to develop both. Therefore, it is important to develop our overall program more rapidly than might be expected in order to encompass the required breadth of activity.

Another factor that places unusual demands on funds for development of the Computer Science Group stems from the combination of the geographical location of the University of Washington and the rapid rate of change that is taking place in the computer science field. In no field is it safe to work for long periods isolated from one's colleagues. Particularly in computer science -- which is changing so very, very rapidly -- it is essential that faculty from the University of Washington have frequent contact with many others in the country who are doing significant teaching and research in the field. Although the University of Washington is in an area with a good supply of bright students interested in the computer science field, it is sufficiently remote from other centers of activity that we do not have automatically a number of people traveling through the area and providing stimulus and contact with research, teaching, and application activities elsewhere in the nation. This factor is less pronounced than it formerly was, but still requires taking special steps to bring visitors to the campus and to have faculty travel elsewhere in order to establish and maintain the communication flow that is essential.

VI. SPECIFIC USES FOR PROPOSED FUNDS

The several ways in which the proposed funds may be used effectively, in the development of our activities in computer science, group logically into three categories. The first of these, referred to below as "communication," relates to the need to promote awareness of national and international activities in computer science, so that the program at the University of Washington will be an active part of -- and contributor to -- the total environment. This will promote awareness of the problems within the field that are important. It will decrease duplication of effort, and will help students and faculty to gain the most from their efforts and, in turn, to make the greatest contribution. The second category has to do with student and faculty development, principally through funding faculty positions and research and teaching associate positions. The third category is concerned with supporting functions. These are easy to overlook, but can have a profound effect upon the program.

A. COMMUNICATION

1. Visiting Faculty

Visiting faculty members can provide new ideas and viewpoints based on experience in other environments. They can provide challenge to accepted ideas and in turn, we hope, are challenged by contact with our faculty members and students. Often such interaction can produce lines of inquiry and investigation that none of the participants would have suspected in advance.

The level of funding requested is intended to provide one such faculty member during each of the three quarters of the academic years in question. The visiting faculty members may come from other universities, or from industry or research institutes. It may be necessary to pay their entire salary, or it may be adequate to supplement a partial income from other sources. The average dollar-level requested is intended to enable acquisition of quite senior people, consistent with the aims of this visiting faculty plan.

2. Colloquium Speakers

On a smaller but still significant scale, similar benefits can be derived by having off-campus speakers deliver some of the lectures in the weekly colloquium series. Intermingling these with lectures delivered by faculty and students on the University of Washington campus provides the dual benefit of bringing in information on outside activities and providing a subtle effect on the standards of selection and presentation of the series.

The University is able to offer honoraria to off-campus speakers, but is not able to support travel costs. Therefore, we are currently dependent on finding off-campus speakers who are near at hand, or who have some other way of supporting the travel costs. However, since the University of Washington is not located at a crossroads of travel, the number of such "free" visitors is limited, and this in turn limits the benefits we can derive.

The funding level requested for this category is intended to provide for the travel expenses only (not honoraria) for four speakers per academic quarter, i.e. twelve per year. Half of these are calculated on the assumption that the speaker would come from the East Coast of the United States and half from the West Coast.

3. Faculty Travel

Another important source of communication with the computer science community stems from travel of faculty members to national and international conferences and to related activities that are en route or near the conference. Some travel of this nature is provided for by research contracts held by faculty members and by the University in support of papers to be presented at conferences. The travel funds requested in this proposal are supplementary in the sense that the intent is to use them for junior faculty members, or for faculty members developing teaching and research along new lines of inquiry. These people are often in greater need of travel and contact with their colleagues than are the more well-established members; yet it is often more difficult to obtain funds for the purpose.

The funds requested are based on the assumption that the three-year period would provide for four to six faculty attending two national symposia per year and two attending the IFIP Congress in the summer of 1971.

4. Advisory Committee

Our continuing examination of the developing Computer Science program at the University of Washington involves both students and faculty on various committees and study groups. There is also a need for more "inputs" from off the campus. One of the healthiest things any group can do -- be it new and developing or old and established -- is to invite constructive criticism and helpful suggestions from those who are experienced in the relevant fields, but who are detached from the local concerns, aspirations, and operating problems. In computer science, one would do well to seek carefully considered comments from a variety of sources, including those experienced in education in the related fields, those who seek the student "products" of the education, and those concerned with the development and the use of computer hardware and software systems. The value of such advice stems more from the freshness of viewpoint than from the relative skills and experience of advisor and advisee.

There are some dangers inherent in establishing such an advisory committee consisting of people who visit infrequently, take a close look at the activities, and make comments and recommendations. Any such group should be established and operated in a way that makes these dangers clear to all concerned and elicits mutual effort to avoid them. For example, this advisory committee should not exist for ulterior motives. Its true purpose should not be to seek ways of influencing the University to provide unwarranted privileges for the Computer Science Group. Nor should it be for the purpose of bringing pressure to bear on the faculty, whether this pressure might come from University administration, the Computer Science chairman, or from a small subgroup of the Computer Science faculty.

To avoid another possible source of difficulty, there should be no explicit or implied necessity to follow the recommendations of the advisory committee.

Rather there should be a spirit of open inquiry and two-way discussion between the committee and the entire Computer Science faculty for the purpose of developing computer science at the University of Washington to its greatest potential. The objective is not to become like some standard-pattern computer science department, but to make the most of the capabilities and opportunities that we have.

The funding request for the advisory committee is based on the assumption that six people meeting twice each year would be a level adequate to provide useful guidance. It is further assumed that the requested funds should provide for the travel and direct expenses incurred by committee members attending the meetings, and that four of them would come from organizations that would continue their salaries while serving on this committee. For the two members from universities, it would probably be necessary to pay some consulting fee in addition to expenses.

B. STUDENT AND FACULTY DEVELOPMENT

1. Faculty Positions

The summary of the current status of the computer science activity at the University of Washington contained in a previous section of this proposal pointed out that there are seventeen faculty members with joint appointments, resulting in approximate full-time-equivalents (FTE) of five faculty members plus one authorized but unfilled position. Four-and-one-quarter of these positions are directly funded through the Computer Science Group; the remainder are funded through other departments. The above discussion of the Computer Science Group's development and plans also emphasized the determination to build significant strength in both the theoretical and applied aspects of computer science. To achieve that end, it is necessary to build simultaneously in both areas. In a few short years, the general character of computer science at the University of Washington will be established and beyond that point it will be possible to augment it and modify it; but it will be very difficult to

make basic changes in its structure and the collective viewpoint of its faculty. It will be important by that time to have added faculty representing theoretical interests as well as software and hardware interests, and to have them mutually aware of the interaction of their special interests within the broad confines of the field. To achieve this, it is essential to build in a broad enough manner and in a short enough period so that the activities do not polarize toward one end of the spectrum to the exclusion of the other.

It is quite clear the the pressures for enrollment and the supply of high-quality students is great enough to warrant addition of two to three faculty members per year for the next several years. However, the demands on the University's resources during this period ahead are so great that it is difficult to allocate the needed funds for faculty positions in the Computer Science Group in the immediate future. Hence the most important part of this proposal is a request for funds that will allow temporary support of new faculty positions with the expectation that the University will be willing to fund these positions on a permanent basis when NSF support is no longer available. The intent of the University administration is to continue to build in the computer science area, and it is recognized that it must be done efficiently through an interdisciplinary program rather than on a piecemeal basis. This intent is put forth in a statement in Appendix G.

Funds are requested in this proposal to support one full professor for a period of three years (1970-71 through 1972-73) and one assistant professor for a period of three years (1971-72 through 1973-74). This support, combined with additional faculty positions supplied by the University, will provide a level of activity that will develop both applied and theoretical activities of Computer Science. (See Table 3.) This should carry the graduate program over the "threshold of viability" that will establish it as a vigorous entity.

2. Graduate Student Assistantships

Many of the necessary teaching and research assistantships for graduate students are already provided for. These include specific research assistant grants and

TABLE 3

FACULTY POSITIONS NEEDED, 1970-1974

	1970-71	1971-72	1972-7	1973-74	1974-75
Cumulative Faculty Level Above Present Base *	2	4	5	6	6
A. Portion of Cumulative Level Requested from NSF	1	2	2	1	0
B. Portion of Cumulative Level to be Supplied by U. of Wash.	1	2	3	5	6

* Present base = 4-½ positions authorized in Computer Science (one currently open) plus estimated 1-3/4 equivalent positions supplemented by other departments.

** This planning cycle extends only through 1973-74, but a portion of the 1974-75 column is shown in order to indicate how the University will maintain continuity of support after temporary NSF funding ceases.

teaching assistant positions that can be filled by graduate students within the Computer Science, Mathematics, and Electrical Engineering departments. The general environment is good, with support possible from grants, contracts, the University Computer Center, and local industry. However, during this period of growth there is need for a few additional assistantships. There are two most important functions these can help fulfill. One is to provide graduate student assistance to new faculty who will need help while formulating and applying for their own research grants. Secondly, the availability of teaching and research assistantships that can be assigned rather flexibly will be a great aid in responding quickly to the very highest quality students who may seek admission to the program but who will be unable to do so without financial aid. Toward that end, we believe that assistantships are of greater value than fellowships since they do imply greater participation in the activities of the Computer Science Group.

Many of the graduates from computer science programs will enter the teaching profession during the next years, both on the college and junior college level and the technical institute training level. It is therefore desirable to give graduate students some teaching experience. Many university departments do employ teaching assistants to teach undergraduate -- and in a few cases beginning graduate -- courses. It is often the case that these students assume these teaching duties without training and without adequate supervision, much to the detriment of the educational process. The reason is fairly obvious: all departments are short of funds and simply cannot spare the faculty time required to give these teaching assistants training and supervision.

In order to do a better job of preparing computer science students for the teaching profession, we would like to institute a formal program. In this program, a graduate student would be assigned to teach part or all of a course under close supervision and guidance from a faculty member. The faculty would attend many if not all of the lectures given by the student and meet regularly with him to provide hints and guidance in teaching techniques. Clearly, such an arrangement requires extra funds in order to pay both the teaching assistant

and the faculty member.

It is worth mentioning that several University departments currently hire Computer Science graduate students to teach elementary programming courses. In this case, the salary of the student is provided by the department offering the course. We would like to include these students in this program and provide the supervisory faculty members.

It is anticipated that with several such students it would be desirable to hold a weekly seminar of discussion on teaching problems and techniques. Academic credit would be given to the graduate student enrolled in this program.

The funds requested for research and teaching assistantships in this proposal are intended to apply to the three principal quarters of the academic year; and to provide four assistantships during the first year of the grant, six during the second, and seven during the third year in accordance with the growing enrollment.

3. Summer Research Support

Well-established faculty members have ample opportunity to arrange for consulting, research grants and contracts, or other sources of support during the summer quarter. However, for new faculty members it is important to have a source of support for the first one or two summers while they are becoming established. Having such funds available will be a great aid to development of the Computer Science Group, since summer support can at times be a deciding factor when one is attempting to recruit new faculty members. In addition, summer support is useful in the cases of established faculty members when they are asked to enter into activities that help develop the group, or to develop new courses to fill gaps in curriculum.

Accordingly, funds are requested in this proposal to provide for the support of three faculty members for two months each during the summers in question. In addition, funds are requested for six full-time student assistantships to

help support these faculty activities as well as to aid those students who happen to have particularly heavy financial requirements.

C. SUPPORTING FUNCTIONS

1. Additions to the Sigma-5 Computer

One demonstration of the University of Washington's interest in computer science and its determination to establish a sound program is its acquisition of a Sigma-5 computer as a principal facility in the Computer Science Laboratory for teaching and research. The system (see Appendix D) is a modest configuration of the Sigma-5 and represents a conscious choice between acquiring a rather elaborate and complete system based on a smaller computer versus acquiring a relatively small version of a machine with greater potential for expansion. The decision made was influenced by the desire to have a system that was expandable and upward compatible, and that provided enough complexity and flexibility to make it a worthy research and teaching tool for a number of years.

As the number of students and faculty increases, it will be desirable to extend the capabilities of this system. Hence this proposal requests funds to add display systems and extra core to the machine. The request is for adequate funds during the first year to add a second storage scope display similar to the Advanced Remote Display System (ARDS) terminal now being acquired. The second year requests funds for addition of another sixteen thousand core locations; and the request for the third year is to cover two additional displays. By the time the third year of this requested grant is at hand, it is possible that other equipment requirements will be of higher priority than the two displays. Hence we request that the funds, if granted, be provided with some flexibility to adapt to our evolving understanding of the most important needs. The needs for the first two years are rather clear, however -- the extra display and the additional core being key items.

2. Library Additions

An important adjunct to any teaching and research activity is the set of library holdings for the principal subject and for the closely related topics. We are fortunate at the University of Washington to have a well-established library and a strong branch -- the Engineering Library -- that has been designated to house the principal collection for Computer Science. (See Appendix H.) The University has supported, and is continuing to support, acquisition of periodicals, reports, and monographs relating to the computer science field; but we feel it is highly desirable to build this collection at a rate faster than is currently possible through University budgets. Hence this proposal requests funds in the amount of $3000 per year for each of the three years to accelerate the development of the Computer Science holdings so that the needed information is more complete and readily available.

3. Secretarial Assistance

Unfortunately, one of the visible economies that can be made around a university is to minimize the amount of secretarial support available. Seemingly invisible is the cost due to less effective use of faculty and facilities due to insufficient backup from secretaries. The Computer Science Group is placing rather severe demands on the available secretarial assistance, both because it is interdisciplinary in nature, requiring an unusually large amount of coordination among departments, and because it is a growing activity and many new files and procedures need to be established.

To help alleviate this problem and to make better use of faculty and facilities, this proposal requests funds to support one secretary for the three-year period. The level of help requested is constant -- rather than increasing with enrollment and with size of the faculty -- because of the effect of the "startup transient." After the initial procedures have been developed and established, the secretarial staff should be able to serve a larger number of students and faculty.

4. Programming Assistance

Most of the programming that will be done for Computer Science teaching and research projects, making use of the Sigma-5 and of the machines in the Computer Center, will be done by graduate students; and it will be considered an important part of their educational process. However, for some of the advanced students who have already acquired the requisite capability, there will be little educational advantage in having them contend with all the details of programs that may be necessary for their research work. To aid them, and to aid faculty members, funds are requested to support one professional programmer for each of the three years in question.

5. Funds for Computing

While much of the machine time used by Computer Science students and faculty will be on the Sigma-5, much of the classroom work in courses will be done on the equipment of the Computer Center; and for some research projects the Computer Center equipment will be more suitable than the Sigma-5. We would also like to explore actively the interconnection of the Sigma-5 with the CDC-6400 in the Computer Center.

While the University subsidizes educational computer work in the Computer Center, we anticipate that our needs for the next few years will exceed that contribution. During the year 1969-70 the Computer Science program has been allocated $3500 for computing services, and it is estimated that a total of $4500 will be needed by the end of the academic year. Next year, 1970-71, an estimated additional ten CPU hours of computing time will be needed. Assuming an hourly rate of $450, this leads to a request for $4500 from the National Science Foundation to supplement the University allocation. In expectation of the growth of the program, $6750 and $8100 are requested for additional computing during the two subsequent years.

VII. FUNDS REQUESTED

A. REQUESTS BY SUBJECT CATEGORIES

1. Cost Summary for Period Covering July 1, 1970 through June 30, 1971

	FIRST YEAR COSTS
Visiting Faculty	$19,800.00
Colloguium Speakers	4,200.00
Faculty Travel	4,000.00
Advisory Committee	8,000.00
Additional Faculty Positions	22,000.00
Graduate Students (TA's and RA's)	14,364.00
Summer Research Support	20,582.00
Additions to Sigma-5 Computer	11,495.00
Library Additions	3,135.00
Secretarial Assistance	6,317.00
Programming Assistance	13,440.00
Computing	4,500.00
FIRST YEAR TOTAL	$131,833.00

(A. REQUESTS BY SUBJECT CATEGORIES)

2. Cost Summary for Period Covering July 1, 1971 through June 30, 1972

	SECOND YEAR COSTS	(First Year Cost Total)	CUMULATIVE TWO-YEAR COST TOTAL
Visiting Faculty	$21,186	$19,800	$40,986.00
Colloquium Speakers	4,200	4,200	8,400.00
Faculty Travel	8,000	4,000	12,000.00
Advisory Committee	8,000	8,000	16,000.00
Additional Faculty Positions	38,253	22,000	60,253.00
Graduate Students (TA's and RA's)	23,058	14,364	37,422.00
Summer Research Support	22,023	20,582	42,605.00
Additions to Sigma-5 Computer	88,825	11,495	100,320.00
Library Additions	3,135	3,135	6,270.00
Secretarial Assistance	6,759	6,317	13,076.00
Programming Assistance	14,381	13,440	27,821.00
Computing	6,750	4,500	11,250.00
TOTALS	$244,570	$131,833	$376,403.00

CUMULATIVE TWO-YEAR TOTAL $376,403.00

(A. REQUESTS BY SUBJECT CATEGORIES)

3. Cost Summary for Period Covering July 1, 1972 through June 30, 1973

	THIRD YEAR COSTS	(Previous Two Years' Cost Total)	CUMULATIVE THREE-YEAR COST TOTAL
Visiting Faculty	$22,671	$40,986	$63,657.00
Colloquium Speakers	4,200	8,400	12,600.00
Faculty Travel	6,000	12,000	18,000.00
Advisory Committee	8,000	16,000	24,000.00
Additional Faculty Positions	40,930	60,253	101,183.00
Graduate Students (TA's and RA's)	28,779	37,422	66,201.00
Summer Research Support	23,563	42,605	66,168.00
Additions to Sigma-5 Computer	22,990	100,320	123,310.00
Library Additions	3,135	6,270	9,405.00
Secretarial Assistance	7,232	13,076	20,308.00
Programming Assistance	15,388	27,821	43,209.00
Computing	8,100	11,250	19,350.00
TOTALS	$190,988	$376,403	$567,391.00

CUMULATIVE THREE-YEAR TOTAL $567,391.00

(A. REQUESTS BY SUBJECT CATEGORIES)

4. Cost Summary for Period Covering July 1, 1973 through June 30, 1974

	FOURTH YEAR COSTS	(Previous Three Years' Cost Total)	CUMULATIVE FOUR-YEAR COST TOTAL
Visiting Faculty	-	$63,657	$63,657.00
Colloquium Speakers	-	12,600	12,600.00
Faculty Travel	-	18,000	18,000.00
Advisory Committee	-	24,000	24,000.00
Additional Faculty Positions	$16,844	101,183	118,027.00
Graduate Students (TA's and RA's)	-	66,201	66,201.00
Summer Research Support	-	66,168	66,168.00
Additions to Sigma-5 Computer	-	123,310	123,310.00
Library Additions	-	9,405	9,405.00
Secretarial Assistance	-	20,308	20,308.00
Programming Assistance	-	43,209	43,209.00
Computing	-	19,350	19,350.00
TOTALS	$16,844	$567,391	$584,235.00

CUMULATIVE FOUR-YEAR TOTAL $584,235.00

(VII. FUNDS REQUESTED)

B. REQUESTS BY ACCOUNTING CATEGORIES

1. Cost Summary for Period Covering July 1, 1970 through June 30, 1971

Salaries		
Faculty	$45,800	
Graduate Students	25,110	
Other Personnel	17,640	
TOTAL SALARIES		$88,550.00
Employee Benefits	7,953	
Equipment	14,630	
Travel	13,300	
Other Direct Costs	7,400	
TOTAL DIRECT COSTS		$43,283.00
INDIRECT COSTS	($34,092 - Not Allowable)	

TOTAL AMOUNT REQUESTED FIRST YEAR $131,833.00

FIRST YEAR TOTAL $131,833.00

(B. REQUESTS BY ACCOUNTING CATEGORIES)

2. Cost Summary for Period Covering July 1, 1971 through June 30, 1972

Salaries		
Faculty	$62,381	
Graduate Students	34,190	
Other Personnel	18,875	
TOTAL SALARIES		$115,446.00
Employee Benefits	10,214	
Equipment	91,960	
Travel	17,300	
Other Direct Costs	9,650	
TOTAL DIRECT COSTS		$129,124.00
INDIRECT COSTS	($44,447 - Not Allowable)	

TOTAL AMOUNT REQUESTED SECOND YEAR $244,570.00

(Total for Previous Year) $131,833.00

CUMULATIVE TWO-YEAR TOTAL $376,403.00

(B. REQUESTS BY ACCOUNTING CATEGORIES)

3. Cost Summary for Period Covering July 1, 1972 through June 30, 1973

Salaries		
Faculty	$66,749	
Graduate Students	40,495	
Other Personnel	20,196	
TOTAL SALARIES		$127,440.00
Employee Benefits	11,123	
Equipment	26,125	
Travel	15,300	
Other Direct Costs	11,000	
TOTAL DIRECT COSTS		$63,548.00
INDIRECT COSTS	($49,064 - Not Allowable)	

TOTAL AMOUNT REQUESTED THIRD YEAR $190,988.00

(Total for Previous Two Years) $376,403.00

CUMULATIVE THREE-YEAR TOTAL $567,391.00

(B. REQUESTS BY ACCOUNTING CATEGORY)

4. Cost Summary for Period Covering July 1, 1973 through June 30, 1974

Salaries		
Faculty	$15,313	
Graduate Students		
Other Personnel		
TOTAL SALARIES		$15,313.00
Employee Benefits	1,531	
Equipment		
Travel		
Other Direct Costs		
TOTAL DIRECT COSTS		1,531.00
INDIRECT COSTS	($5,896 - Not Allowable)	

TOTAL AMOUNT REQUESTED FOURTH YEAR $16,844.00

(Total for Previous Three Years) $567,391.00

CUMULATIVE FOUR-YEAR TOTAL $584,235.00

(VII. FUNDS REQUESTED)

C. RELATIVE PRIORITIES

There is a recognized need for all of the categories of assistance that are requested in the proposal. However, the relative priorities of these needs differ. In recognition of the unknown amount of funding available in the event that this proposal generally meets NSF approval, we believe that a statement of our current assessment of these relative priorities will be helpful. Our priority ranking, starting with the most important items first, is as follows:

1. Faculty Positions
2. Summer Research Support
3. Graduate Student Assistantships
4. Computer Hardware
5. Visiting Faculty
6. Faculty Travel
7. Colloquium Speakers
8. Advisory Committee
9. Library Additions
10. Secretarial Assistance
11. Funds for Computing
12. Programming Assistance

This priority ranking is to serve as a rough guide. If it is necessary to consider such ranking more closely, it may prove desirable in some cases to alter the relative amount of several categories rather than completely eliminating some of those of lower priority.

APPENDIX A

FACULTY VITAE

The vitae of the faculty members associated with the Computer Science Group are presented in the following pages. The ways in which they interact with the group vary and fall into three categories, all of which play important roles. The categories -- and the "members" of each -- are as follows:

1. Those funded by other departments but whose contributions to the Computer Science program take the form of teaching, supervising theses, and conducting related research -- as well as participating in the planning of the group's activities. These part-time associations are counted as making up the "full-time-equivalent" Computer Science faculty supported by other departments. Faculty in this category are Professors Holden, Johnson, Kehl, and Ritchie.

2. Those funded by other departments and whose contributions to the Computer Science program take the form of liaison, planning through participation in committees, and serving on examining boards and thesis committees. Faculty in this category are Professors Cramer, Diehr, Gillespie, Goldstein, Lewis, Pyke, and Stanfield.

3. Those funded directly through the Computer Science Group budget either completely or in part. These members are counted as making up the "full-time-equivalent" faculty funded through the group. Faculty in this category are Professors Baer, Dekker, Golde, Hunt, Noe, and Rockafellar.

An important fourth group that is not included among the attached vitae consists of faculty members who teach electrical engineering and mathematics courses for which credit is given toward Computer Science degree fulfillment even though the faculty members are not formally involved in the group. Through this mechanism, these other departments are giving substantial support to the Computer Science Group.

Jean-Loup Edgar Baer

Assistant Professor, Computer Science and Electrical Engineering

Birth: September 12, 1936

Education: B.S., University of Grenoble, 1961
M.S., University of Grenoble, 1963
Ph.D., University of California at Los Angeles, 1968

Professional Societies:

Sigma Xi
Association for Computing Machinery
Institute of Electrical and Electronics Engineering
AFCET

Publications:

1968

"Compilation of Arithmetic Expressions for Parallel Computations." (With D.P. Bovet), Booklet B of I.F.I.P. Congress Proceedings, 1968, pp. B4-B10.

"Modelling and Scheduling of Computer Programs for Parallel Processing Systems." (With E.C. Russell), Proceedings 2nd Conference on Application of Simulation, 1968, pp. 278-281.

1969

"Frequency Numbers Associated with Graph Models of Computations." (With G. Estrin), Proceedings 2nd Hawaii International Conference on System Sciences, 1969, pp. 139-142.

In Press

"Bounds for Maximum Parallelism in a Bilogic Graph Model of Computations." (With G. Estrin), Digest of the I.E.E.E. Computer Group Conference.

"Preparation and Evaluation of Computer Programs for Parallel Processing Systems." (With E.C. Russell), Proceedings of the Symposium on Parallel Processor Systems, Monterey, 1969.

John G. Cramer

Associate Professor of Physics
and Computer Science

Birth: October 24, 1934

Education: M.A., Rice University, Texas, 1957
Ph.D., Rice University, 1961

Professional Societies:
American Physical Society
Institute of Electronic and Electrical Engineers
Society of Sigma Xi

Publications:

1960

"Measurement and Analysis of High-Energy Beta Spectra of Light Elements" (with B. J. Farmer and C. M. Class). Bulletin of the American Physical Society. 5:101. 1960.

1962

"A Scintillation Spectrometer for High Energy Beta Decays" (with B.J. Farmer and C. M. Class). Nuclear Instruments and Methods. 16:289. 1962.

"The Beta Decay of Sc^{41}" (with C. M. Class). Nuclear Physics. 34:580. 1962.

"The Production of Unnatural Parity States by Inelastic Alpha-Particle Scattering" (with W. W. Eidson). Physical Review Letters. 9:497. 1962.

1963

"Correlation Studies of the Alpha Particle Breakup of the 9.6 MeV 3^- State in C^{12} Induced by (d, d') Scattering" (with R. A. LaSalle and W. W. Eidson). Physics Letters. 5:170. 1963.

"d-γ Angular Correlations in the Si^{28} $(\alpha, \alpha'\gamma)$ Reaction" (with D. E. Blatchley and R. D. Bent). Bulletin of the American Physical Society. 8:47. 1963.

"Elastic and Inelastic Scattering of Alpha Particles from O^{16}, Mg^{24}, and Si^{28}" (with W. W. Eidson). Bulletin of the American Physical Society. 8:317. 1963.

"An Integrated Computer-Analyzer System for Real-Time Reduction of Multi-Parameter Data" (with W. W. Eidson). Proceedings of the International Symposium on Nuclear Electronics, Paris. 1963.

1964

"Angular Correlations and Nuclear Polarization from the Inelastic Scattering of Alpha Particles" (with W. W. Eidson). Nuclear Physics. 55:593 1964.

"Angular Correlation Studies of Nuclear Polarization Following Inelastic Alpha-Particle Scattering from C^{12} and Mg^{24}." Nuclear Physics. 55:613. 1964.

"The Correction of Resolution Distortion in Continuous Pulse-Height Spectra." (With D. E. Wortman) Nuclear Instruments and Methods. 26:257. 1964.

"Angular Correlations with Strongly Absorbed Particles." (With J. G. Wills) Bulletin of the American Physical Society. 9:505. 1964.

"Nuclear Polarization of C^{12}, Mg^{24} and Fe^{56} Produced by the Inelastic Scattering of Alpha Particles." (With G. P. Eckley and W. W. Eidson). Bulletin of the American Physical Society. 9:418. 1964.

"Angular Correlation Studies of the Reaction C^{12} (d, d') C^{12*} (d_b) Be^8." (With R. A. LaSalle, R. D. Bent) Bulletin of the American Physical Society. 9:407. 1964.

"Design Study for a Multi-Parameter Analysis System." (With W. W. Eidson) Bulletin of the American Physical Society. 9:488. 1964.

"Angular Momentum Selection and Angular Correlations in Direct Reactions with Strongly Absorbed Particles." (With J. G. Wills) Nuclear Spectroscopy with Direct Reactions. I. Argonne National Laboratory Report ANL-6848. Pp.147. 1964.

"Angular Correlation Studies of the Inelastic Scattering of Alpha Particles from C^{12} Mg^{24}, Si^{28}, and Fe^{56}." (With W. W. Eidson and D. E. Blatchley). Nuclear Spectroscopy with Direct Reactions I. Argonne National Laboratory Report ANL-6848. 153pp. 1964.

1965

"Alpha-Gamma Correlation Study of the ^{56}Fe $(\alpha, \alpha' \gamma_{0.84})$ ^{56}Fe Reaction." (With W. W. Eidson and G. P. Eckley). Physics Letters. 18:34. 1965.

1966

"Proton Spin-Flip in the Reaction C^{12} (p,p') C^{12*} (4.43) from 12 to 15 MeV." (With F. H. Schmidt, and W. A. Kolasinski) Bulletin of the American Physical Society. 11:99. 1966.

"Proton Spin-Flip in the Reaction Ni^{60} (p,p') Ni^{60*} (1.33) at 10.5 and 14.0 MeV." (With W. A. Kolasinki and F. H. Schmidt) Bulletin of the American Physical Society. 11:100. 1966.

1966 (cont.)

"Proton Spin-Flip in Inelastic Scattering Leading to First Excited States in Nickel Isotopes." (With R. H. Schmidt and W. A. Kolasinski) Bulletin of the American Physical Society. 11:751. 1966.

"Energy Dependence of the Phase Rule in Mg^{24} (α,α') Scattering." (With R. A. Hinrichs and W. J. Braithwaite) Proceedings of the International Conference on Nuclear Physics. Gatlinburg, Tenn. September 12-17. 1966.

"Energy Dependence of the Phase Rule in Mg^{24} $(\alpha\ \alpha')$ Scattering." (With R. A. Hinrichs and W. J. Braithwaite). Bulletin of the American Physical Society. 11:908. 1966.

"The Biased Quadrupole: A Method of Steering Accelerator Beams." (With F. H. Schmidt). Nuclear Instruments and Methods. 45:325-327. 1966.

"The Charge Distribution of O^{16} Ions Produced from a Tandem Accelerator." (With E. Preikschat). Review of Scientific Instruments. 37:1722-1726. 1966.

"Research with the University of Washington FN Tandem Accelerator." APS meeting at Stanford University, December 1966 (invited paper).

1967

"Proton Spin-Flip Measurements on a $d_{3/2}$ Analog Resonance in Nb^{91}." (With P. Richard). Bulletin of the American Physical Society. 12:527. 1967.

"Inelastic Alpha Scattering on Silicon Isotopes." (With W. J. Braithwaite, J. P. Allen, and E. Preikschat). Bulletin of the American Physical Society. 12:913. 1967.

"Proton Spin-Flip in the Reaction Ni^{58} (p,p') Ni^{58*} (1.95) at 15.0 MeV." (With W. A. Kolasinski and F. H. Schmidt). Bulletin of the American Physical Society. 12:921. 1967.

"Study of the Spectroscopic Factor Between 6 and 11 MeV in the Zr^{90} (d,p) Reaction." (With R. A. Hinrichs, G. W. Phillips and D. L. Oberg). Bulletin of the American Physical Society. 12:922. 1967.

"A Search for Singlet Deuterons in the Reaction C^{12} $(\alpha\ ,pn)N^{14*}$". (With W. J. Braithwaite, W. W. Eidson and F. W. Slee). Bulletin of the American Physical Society. 12:1198. 1967.

1968

"Identification of 1^- Neutron Particle-Hole States in ^{140}Ce." (With P. von Brentano, W. J. Braithwaite, W. W. Eidson and G. W. Phillips). Physics Letters. 26B:448. 1968.

"Identification of 1^- Neutron Particle-Hole States in ^{208}Pb." (With P. von Brentano, H. Ejiri, S. M. Ferguson and G. W. Phillips). Bulletin of the American Physical Society. 13:656. 1968.

"A Computer Program for the Calculation of Tandem Accelerator Beam Tube Optics." Nuclear Instruments and Methods. 62:205. 1968.

"An Estimate of the ^3He Spin-Orbit Potential from Spin-Flip Measurements." (With D. M. Patterson). Physics Letters. 27B:373. 1968.

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1969

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David B. Dekker

Associate Professor, Mathematics and Computer Science and Graduate Program Advisor, Computer Science

Birth: May 28, 1919

Education: A.A., Glendale Jr. College, 1939
A.B., University of California at Berkeley, 1941
M.S., Illinois Institute of Technology, 1943
Ph.D., University of California at Berkeley, 1948

Professional Societies:

Sigma Xi
Phi Beta Kappa
American Mathematical Society
Society for Industrial and Applied Mathematics
Mathematical Association of America
Association for Computing Machinery

Publications:

1949

"Hypergeodesic Curvature and Torsion." Bulletin of the American Mathematical Society, Vol. 55, (1949), pp. 1151-1168. (Doctoral Dissertation)

1951

"Generalizations of Hypergeodesics." Pacific Journal of Mathematics, Vol. 1, (1951), pp. 53-57.

1954

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1955

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1957

"The University Computer Laboratory." The Trend in Engineering, January 1957, p. 12.

George E. Diehr

Assistant Professor, Finance, Business Economics,
Quantitative Methods, and Computer Science

Birth: May 7, 1941

Education:

B.S., Engineering, Harvey Mudd College, Claremont, 1963
M.B.A., Data Processing, UCLA, 1966
PhD., Quantitative Methods, UCLA, 1968 (dissertation not completed)

Professional Societies:

Institute of Management Sciences
American Statistical Association
Association for Computing Machinery

Publications:

None

Robert G. Gillespie

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Birth: May 18, 1933

Education: B.A., Mathematics, Reed College, Portland, Oregon, 1955.

Professional Societies:

American Mathematical Society
Society for Industrial and Applied Mathematics
American Institute of Astronautics and Aeronautics
(member of the Computing Systems Committee)
Association for Computing Machinery
(representative to AFIPS Committee on Public Information)

Publications:

1958

"On the Analysis of Sequential Machines." (With D. Aufenkamp), IRE Transactions on Electronic Computers, June 1958.

1969

"Purchasing Packaged Software--A Customer's Point of View." (With D. Burke), Computers and Automation, February 1969.

Hellmut Golde

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Education: Diplom-Ingenieur, Technische Hochschule, Munich, Germany, 1953
M.S., Stanford University, 1954
Ph.D., Stanford University, 1959

Professional Societies:

Sigma Xi
Institute of Electrical and Electronics Engineering
Association for Computing Machinery

Publications:

1960

"Theory and Measurement of Q in Resonant Ring Circuits." IRE Trans. Microwave Theory and Techniques, Vol. MTT-8, No. 5, (September 1960), pp. 560-564.

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1961

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1962

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1963

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1966

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1967

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1969

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Allen A. Goldstein

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Birth: January 7, 1925

Education: B.A., St. John's College, 1947
M.A., Georgetown University, 1952
Ph.D., Georgetown University, 1954

Professional Societies:

American Mathematical Society
Association for Computing Machinery

Publications:

1952

"A Collision Path from the Earth to the Moon in the Restricted Problem of Three Bodies." (With C.E. Froberg), Kungl. Fysiografiska I Lund Forhandlinger, Bd. 22, Nr. 14, 1952, pp. 1-3.

1954

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1957

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1958

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1959

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1962

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1963

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1964

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1965

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1966

"Minimizing Functionals on Normed Linear Spaces." Journal SIAM Control, Vol. 4, No. 1, pp. 81-89.

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Alistair D. C. Holden

Assistant Professor, Electrical Engineering and Computer Science

Birth: November 8, 1928

Education: Scottish Universities' Certificate of Fitness
B.Sc., Electrical Engineering, University of Glasgow, 1955
M.Eng. Electrical Engineering, Yale University, 1958
Ph.D., Electrical Engineering, University of Washington, 1964

Professional Societies:

Association for Computing Machinery
Institute of Electrical and Electronic Engineers
New York Academy of Sciences
Biomedical Engineering Society
Sigma Xi
International Cybernetics Congress Committee (London)
Chairman - International Joint Conference on Artificial Intelligence Washington D. C., 1969

Publications:

1964

"Simulation of Human Problem-Solving Methods" (With D.L. Johnson), Proc. National Electronics Conference, Vol. XIX, 1963. (Also selected for Reprise Section, Simulation Journal, Vol. III, August, 1964).

"A Problem-Solving Machine with the Capacity to Learn From Its Experience" (With D.L. Johnson), Simulation Journal, Vol. III, August 1964.

1965

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1966

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"Simulation of the Growth of Scientific Reasoning in the Child," (With D.L. Johnson), Proc. Bionics Symposium, 1966.

1967

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Reviewed: Computing Reviews, 9, No. 1, January 1968.
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1969

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"Problem Solving in General Algebraic Structures," (With Al J. Robinson). Submitted to Transactions, IEEE.

Earl B. Hunt

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Professional Societies:

American Psychological Association, Psychometric Society
American Association for the Advancement of Science
Psychonomic Society
New York Academy of Science
Phi Beta Kappa
Sigma Xi
Psi Chi

Publications:

1960

"The Computer Simulation of Concept Attainment." Behavioral Science, (With C. Hovland), Vol. 5, (1960), pp. 265-267.

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1961

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1962

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1963

"Simulation and Analytic Models of Memory," J. Verbal Learning and Verbal Behavior, Vol. 2, 1963, pp. 49-59.

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1964

"Psychological Research and Programmed Instruction," Proc. University of New South Wales Conference on Programmed Instruction, 1964.

1965

"Selection and Reception Conditions in Grammar and Concept Learning," J. Verbal Learning and Verbal Behavior, Vol. 4, (1965), pp. 211-215.

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1966

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"Inverse Forgetting in Short Term Memory," (With June Crawford and G. Peak), Journal of Experimental Psychology, Vol 72, (1966), pp. 415-422.

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1967

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1968

WRITEACOURSE: An Educational Programming Language," Proc: Fall Joint Computer Conference, 1968. (With Mary Zosel).

David L. Johnson

Professor, Electrical Engineering and Computer Science

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Education: B.S., University of Idaho, 1948
Ph.D., Purdue University, 1955

Professional Societies:

Institute of Electrical and Electronics Engineering
Association for Computing Machinery
Sigma Tau
Eta Kappa Nu
Tau Beta Pi
Sigma Xi

Publications:

1956

"Digital Computer Solution of Stability Problems." (With J. B. Ward), Electrical Engineering, November 1956, p. 1027.

"Digital Computer Solution to Determine Economical Use of Hydro Storage." AIEE Transactions, Vol. 75, No. 3, (1956), pp. 1153-56.

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1957

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Discussion: "Digital Solutions for Large Power Networks." (R. F. Brown, W. F. Tinney), Power Apparatus and Systems, June 1957, p. 351.

1958

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1959

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1962

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"The Man-Computer Relationship." (With Arthur Kobler), Science, Vol. 138 (November 1962), p. 873.

1963

"Variational Methods of Hydro-Usage Optimization." (With P. R. Menon), Proceedings PICA Conference, IEEE, April 1963.

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"Automated Chess Playing: Moving Toward Simulated Intelligence." The Trend in Engineering, October 1963.

"Simulation of Human Problem-Solving Methods." (With A. D. C. Holden), Proceedings of National Electronics Conference, 1963.

"Variational Methods of Hydro-Usage Optimization," (With P. Menon), IEEE Transactions, 1963.

1964

"What is Your Computer Attitude?" (With Arthur Kobler), IEEE Journal, March 1964.

"A Problem-Solving Machine with the Capacity to Learn from its Experience." (With A. D. C. Holden), Simulation (IEEE and AFIPS), August 1964.

1966

"Computer Learning in Theorem Proving." (With A.D.C. Holden), IEEE 1966 International Convention Record. Also IEEE Transactions, Systems Science and Chemistry, 1967.

"The Application of Ternary Memory Elements." (With K. O'Keefe), Proc. 1966 Bionics Symposium.

"Simulation of Growth of Scientific Reasoning in the Child." (With A. D. C. Holden). Proc. 1966 Bionics Symposium.

1968

"Computers in the Engineering College Curriculum," Journal of ASEE, Vol. 58, No. 13, 1968.

"The Evolution of Threshold Logic Networks which Realize Binary Patterns," (With T. A. Marsland), Con. Rec. AIEE, Systems Science and Cybernetics.

"The Application of Shift Registers to Secondary State Assignment, Part I," (With K. O'Keefe), IEEE Transactions on Computers, Vol. C-17, No. 10, (1968), pp. 954-965.

"The Application of Shift Registers to Secondary State Assignment, Part II," (With K. O'Keefe), IEEE Transactions on Computers, 1968, Vol. C-17, No. 10, pp. 966-977.

Theodore H. Kehl

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Birth: April 1, 1933

Education: B.S., University of Wisconsin, 1956
M.S., University of Wisconsin, 1958
Ph.D., University of Wisconsin, 1961

Professional Societies:

Association for Computing Machinery
American Association for the Advancement of Science
Sigma Xi
Gamma Alpha
Phi Sigma (Biology)

Publications:

1960

"Peripheral nerve function and hibernation in the thirteen-lined ground squirrel spermophilus tridecemlineatus," (With P. Morrison), in Mammalian Hibernation C. P. Lyman and A. R. Dawe, editors. Cambridge, Mass., Bulletin of the Museum of Comparative Zoology at Harvard College, 1960, pp. 387-404.

1963

"Data Acquisition and Computing System for Biological Research." Proceedings 16th Annual Conference on Engineering in Medicine and Biology 5, 1963, pp. 139-140.

1964

"Analysis of a Multi-variable Physiological System: Control of Stroke Volume in the Unanesthetized Dog." (With A. M. Scher and A. C. Young), Proceedings 17th Annual Conference on Engineering in Medicine and Biology 6, 1964, p. 26.

1965

"Applications of Computers to Medicine." (With A. M. Scher), Proceedings 6th Winter Convention on Military Electronics, Vol. 4, 1965, 11B10-11B12.

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"A Multivariable Control System: Determinants of the Stroke Volume of the Heart." (With A. M. Scher and A. C. Young), Science, Vol. 150, (1965), pp. 383-384.

1966

"Factors determining the stroke volume." (With A. M. Scher), Federation Proceedings, Vol. 25, (1966), p. 205.

1967

"A Model of Stroke Volume Control in the Resting Dog," (With A. M. Scher), in Physical Bases of Circulatory Transport: Regulation and Exchange. E. B. Reeve and A. C. Guyton, eds. Philadelphia: W. B. Saunders Co., 1967, pp. 121-128.

1968

"The Regulation of the Stroke Volume in the Resting, Unanesthetized Dog." (With A. C. Young and A. M. Scher), Computers and Biomedical Research, Vol. 1, (1968), pp. 315-336.

"Interactive Real-time Computation," Computers and Biomedical Research, Vol. 1, (1968), pp. 590-604.

"Systems Programming On-Line." (With C. Moss), Computers and Biomedical Research Vol. 1, (1968), pp. 550-555.

Laurel J. Lewis

Professor, Electrical Engineering

Birth: November 29, 1911

Education: A.B., Stanford University, 1933
E.E., Stanford University, 1935
Ph. D., Stanford University, 1947

Professional Societies:

Institute of Electrical and Electronics Engineers
Association for Computing Machinery
Phi Beta Kappa
Tau Beta Pi
Sigma Xi

Publications:

1961

"A Computer Program for Lens Design." Technical Report--Applied Physics Laboratory, University of Washington, Seattle, Washington. September 1961.

1962

"Discussion of Paper by C. C. Hsu, 'A new Graphical Method for Feedback Control System Compensation Design'." AIEE Transactions, Vol. 61, 1962.

"Discussion of paper by B. G. Sokkappa, 'Optimum Scheduling of Hydro-thermal Systems'." AIEE Transactions, Vol. 61, 1962.

1965

POLO, A Computer Programming System for Polynomial Operations. Technical Report No. 96, Dept. of Electrical Engineering, University of Washington, April 1965.

Jerre D. Noe

Professor, Electrical Engineering
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Professor and Chairman, Computer Science

Birth: February 1, 1923

Education: B.S., Electrical Engineering, U. of California, Berkeley, 1943
Ph.D., Stanford University, 1948

Professional Societies:

Eta Kappa Nu
Tau Beta Pi
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Institute of Electrical and Electronics Engineering
IEEE Group on Electronic Computers (National Chairman 1956-57, Member Administrative Committee 1954-55)
IEEE Education Group (Member Administrative Committee, 1969-71)
Association for Computing Machinery

Research Administration: (Stanford Research Institute)

Executive Director, Information Science and Engineering, 1961-1968. This research division consisted of a group of laboratories doing R & D in computer hardware and software, instrumentation and control.

Assistant Director of Engineering Division, 1954-61

Publications:

1947

"Receiver Output Circuits," (With Buss, Clark and Overacker), Ch. 34 of V. H. F. Techniques, McGraw-Hill, 1947.

1948

"Distributed Amplification," (With Ginzton, Hewlett, Jasberg), IRE Proceedings, August 1948.

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1950

"Distributed Amplifiers: Practical Considerations and Experimental Results," (With W. H. Horton and J. H. Jasberg), IRE Proceedings, July 1950, p. 748.

1954

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1955

"Data Processing Systems: How They Function," Control Engineering, October 1955, 7 pp.

"Electronics in Financial Accounting," (With Bennett, Eldredge, Morrin and Whitby), FJCC Proceedings, November 17, 1955, 29pp.

1962

"Optical Character Recognition," Conference Proceedings, 1962.

"Training System Design Engineers," IRE Trans Education, Vol. 55, Nos. 3 and 4, (September 1962).

Ronald Pyke

Professor, Mathematics, Biomathematics and Computer Science

Birth: November 24, 1931

Education: B.A., McMaster University, 1953
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Professional Societies;-

Institute of Mathematical Statistics
American Mathematical Society
Mathematical Association of America
Canadian Mathematical Congress
Sigma Xi
American Statistical Association Fellow
AAAS

Publications:

1955

"The Statistical Theory of Some Population Migration Models." (With D. G. Chapman), Technical Report No. 22, University of Washington. Contract N8onr-520 II No. NR-042-036. March 1955.

1958

"On Some Distributions Related to the Statistic D_n^+." (With Z. W. Birnbaum), Annals of Mathematical Statistics, Vol. 29, (1958), pp. 179-187.

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1959

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"On Conditional Expectation and Quasi-Rings." (With M. V. Johns), Pacific Journal of Mathematics, Vol. 9, (1959), pp. 715-722.

1960

"The Content of a Dam as the Supremum of an Infinitely Divisible Process." (With J. Gani), Journal of Mathematics and Mechanics, Vol. 9, (1960), pp. 639-652.

"On Centering of Infinitely Divisible Processes." Annals of Mathematical Statistics, Vol. 31, (1960), pp. 797-800.

1961

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1962

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1963

E. B. Dymkin, Theory of Markov Processes (Prentice-Hall, N.H., 1961) in Annals of Mathematical Statistics, 1963, 7 pp. (Book review).

"Combinatorial Results in Multi-Dimensional Theory." (With Charles Hobby), Annals of Mathematical Statistics, Vol. 34, (1964), pp. 402-404.

"Combinatorial Results in Fluctuation Theory." (With Charles Hobby), Annals of Mathematical Statistics, Vol. 34, (1963), pp. 1233-1242.

"A Combinatorial Theorem Related to Comparisons of Empirical Distribution Functions." (With Charles Hobby), Zeitschrift fur Wahrscheinlichkeitstheorie. Vol. 2, (1963), pp. 85 89.

"Remarks on the Equivalence Principle in Fluctuation Theory." (With Charles Hobby), Mathematica Scandinavica, Vol. 12, (1963), pp. 19-24.

1964

"Asymptotic Normality of Certain Test Statistics of Exponentiality." (With Frank Proschan), Biometrika, Vol. 51, (1964), pp. 253-256.

"Limit Theorems for Markov Renewal Processes." Annals of Mathematical Statistics, Vol. 35, (1964), pp. 1746-1764.

1965

"Doubly Stochastic Operators Obtained from Positive Operators." (With Charles Hobby), Pacific Journal of Mathematics, Vol. 15, (1965), pp. 153-157.

"The Asymptotic Relative Efficiency of Goodness-of-fit Tests Against Scalar Alternatives." Journal of American Statistical Association, Vol. 60, (1965), pp. 410-419.

"Spacings." Jour. Royal Statistical Society, Series B, Vol. 27, (1965), pp. 395-449.

"The Robins-Isbell Two-armed-bandit Problem with Finite Memory." (With Carter V. Smith). The Annals of Mathematical Statistics, Vol. 36, (1965), pp. 1375-1386.

1966

"The Existence and Uniqueness of Stationary Measures for Markov Renewal Processes," (With Ronald Schaufele), Ann. Math. Statis.,1966, pp. 1439-1462.

1967

"Tests for monotone Failure Rate." (With F. Proschan), Proc. Fifth Berkeley Symp. Prob. Stat., Vol. 3, (1967), pp. 293-312.

"Obituary of Professor Marek Fisz." Z. Wahrscheinlichkeitstheorie, (1967), 8. pp. 153-156.

1968

"The Weak Convergence of the Empirical Process With Random Sample Size." Proc. Camb. Phil. Soc., Vol. 64, (1968), pp. 155-160.

"Weak Convergence of a Two-sample Empirical Process and a New Approach to Chernoff-Savage Theorems." (With G. R. Shorack), Ann. Math. Statist., Vol. 39, (1968), pp. 755-771.

"Estimation of the Transition Distributions of a Markov Renewal Process." (With Erin Moore). Ann. Statist. Math., Vol. 20, (1968), pp. 411-424.

"Weak Convergence and a Chernoff-Savage Theorem for Random Sample Sizes." (With G. R. Shorack), Ann. Math. Statist., Vol. 39, (1968), pp. 1675-1685.

"On Convergence in r-mean of Normalized Partial Sums." (With David Root), Ann. Math. Statist., Vol. 39, (1968), pp. 379-381.

Robert W. Ritchie

Vice Provost for Academic Administration
and
Associate Professor, Mathematics and Computer Science

Birth: September 21, 1935

Education: A.B., Reed College, 1957
M.A., Princeton, 1959
Ph.D., Princeton, 1961

Professional Societies:

Phi Beta Kappa
Sigma Xi
American Mathematical Society
Mathematical Association of America
Association for Symbolic Logic
American Association of University Professors

Publications:

1959

"A Generalization of Noncommutative Jordan Algebras." Proceedings of the Amer. Math. Soc., Vol. 10, No. 6, (December 1959), pp. 926-930.

1960

"Conditions for the Power-associativity of Algebras." (With J.D. Leadley), Proc. Amer. Math. Soc., Vol. 11, No. 3, (June 1960), pp. 399-405.

1963

"Classes of Predictably Computable Functions." Transactions of the American Mathematical Society, Vol. 106, No. 1 (January 1963), pp. 139-173.

New Directions in Mathematics. Kemeny, Robinson and Ritchie (edited by Ritchie) Prentice-Hall. 1963. 124 pp. + 5.

"Finite Automata and the Set of Squares." Journal of the Association for Computing Machinery, Vol. 10, No. 4 (October 1963), pp. 528-531.

1964

"Predictably Computable Functionals and Definition by Recursion." (With D.L. Kreider), Zeitschrift fur math. Logik und Grundlagen d. Math., Bd 10 (1964), s. 65-80.

1965

"Classes of Recursive Functions Based on Ackermann's Function." Pacific Journal of Mathematics, Vol. 15, No. 3, 1965. pp. 1027-1044.

"A Rudimentary Definition of Addition." Journal of Symbolic Logic, Vol. 30, No. 3, (September 1965), pp. 350-354.

1966

"A Universal Two-way Automaton." (With D.L. Kreider), Archiv fur math. Logik und Grundlagenforschung, 1966.

"A Basis Theorem for a Class of Two-way Automata." (With D.L. Kreider), Zeitschrift fur math. Logik und Grundlagen d. Math., Bd. 12, 1966. s. 243-255.

1968

"Marking Automata and Context-free Languages." Proceedings of the Second Annual International Symposium of System Sciences at the University of Hawaii, January 1968.

1969

"Strong Representability of Partial Functions in Arithmatic Theories" (With Paul R. Young), Information Sciences, Vol. 1, (1969), pp. 189-204.

"On the Generative Power of Transformational Grammars." (With P. Stanley Peters) (to appear in Information Sciences, 1969 or 1970).

"On the Universal Base Hypothesis," (With Stanley Peters), Journal of Linguistics, March 1969.

"Context Sensitive, Immediate Constituent Analysis -- Context-free Languages Revisited," (With P. Stanley Peters), Proc. of ACM Symposium on Theory of Computing, Marina del Rey, California, May 1969.

Ralph T. Rockafellar

Associate Professor, Mathematics and Computer Science

Birth: February 10, 1935

Education: A.B., Harvard College, 1957
M.S., Marquette University, 1959
Ph.D., Harvard University, 1963

Professional Societies:

American Mathematical Society
Society for Industrial and Applied Mathematics

Publications:

1963

Convex Functions and Dual Extremum Problems, Doctoral dissertation, Harvard, 1963, 166 pp.

1964

"Duality Theorems for Convex Functions." Bull. Amer. Math. Soc., Vol. 70, (1964), pp. 189-192.

"A Combinatorial Algorithm for Linear Programs in the General Mixed Form." J. Soc. Indust. Appl. Math., Vol. 12, (1964), pp. 215-225.

"A Necessary Condition for the Existence of Best Approximations." (With B. Kripke), J. Math. and Mech., Vol. 13, (1964), pp. 1937-1938.

"Minimax Theorems and Conjugate Saddle-functions." Math. Scand., Vol. 14, (1964), pp. 151-173.

1965

"On the Subdifferentiability of Convex Functions." (With A. Brøndsted), Proc. Amer. Math Soc., Vol. 16, (1965), pp. 605-611.

"Helly's Theorem and Minima of Convex Functions." Duke Math. J., Vol. 32, (1965), pp. 381-398.

1966

"Extension of Fenchel's Duality Theorem for Convex Functions," Duke Math. J., Vol. 33, (1966), pp. 81-90.

"Level Sets and Continuity of Conjugate Convex Functions, Trans. Amer. Math. Soc., Vol. 123, (1966), pp. 46-63.

1966 (cont.)

"Characterization of the Subdifferentials of Convex Functions," Pacific J. Math., Vol. 17, (1966), pp. 497-510.

1967

"A Monotone Convex Analog of Linear Algebra," Proceedings of the Colloquium on Convexity, Copenhagen, 1965, pp. 261-276.

"Conjugates and Legendre Transforms of Convex Functions," Canad. J. Math., Vol. 19, (1967), pp. 200-205.

Monotone Processes of Convex and Concave Type, Memoirs of the Amer. Math. Soc., No. 77 (1967), 74 pp.

"Convex Programming and Systems of Elementary Monotonic Relations," J. Math. Anal. Appl, Vol. 19, (1967), pp. 543-564.

"A Model of Cell Cleavage," (With H. Prothero), Biophysical J., Vol. 7, (1967), pp. 659-673.

"Duality and Stability in Extremum Problems Involving Convex Functions," Pacific J. Math., Vol. 21, (1967), pp. 167-187.

1968

"A General Correspondence Between Dual Minimax Problems and Convex Programs," Pacific J. Math., Vol. 25, (1968), pp. 597-611.

"Convex Functions on Convex Polytypes," (With D. Fale and V. L. Klee), Proc. Amer. Math. Soc., Vol. 19, (1968), pp. 867-873.

"Integrals Which Are Convex Functionals," Pacific J. Math, Vol. 24, (1968), pp. 525-540.

1969

Convex Analysis, Princeton Mathematical Series, Vol. 28, Princeton University Press, 1969, 500 pp.

"Convexity Properties of Nonlinear Maximal Monotone Operators," Bulletin Amer. Math. Soc., Vol. 75, (1969), pp. 74-77.

"Gradients of Convex Functions," (With E. Asplund), Trans. Amer. Math. Soc., May 1969.

Jonathan Stanfield

Assistant Professor, Librarianship and Computer Science

Birth: December 23, 1938

Education: B.A., Cambridge, U.K., 1960
Ph.D., Cambridge, U.K., 1965

Professional Societies:

American Society for Information Science

Publications: None

Appendix B

The Graduate Degree Program
in
Computer Science
at
The University of Washington

See Computer Science Brochure
(included separately)

APPENDIX C

UNIVERSITY OF WASHINGTON COMPUTER CENTER FACILITIES

The Computer Center provides computing services for students, faculty, and the university administration for research, teaching, and university accounting functions. The principal equipment utilized is as follows:

CDC-6400
Burroughs B-5500
Cal-Comp 563 Drum Plotter
EAI-3500 Table Plotter
Benson-Lehner Digital Recording System
The Analytical Plotter/Model C

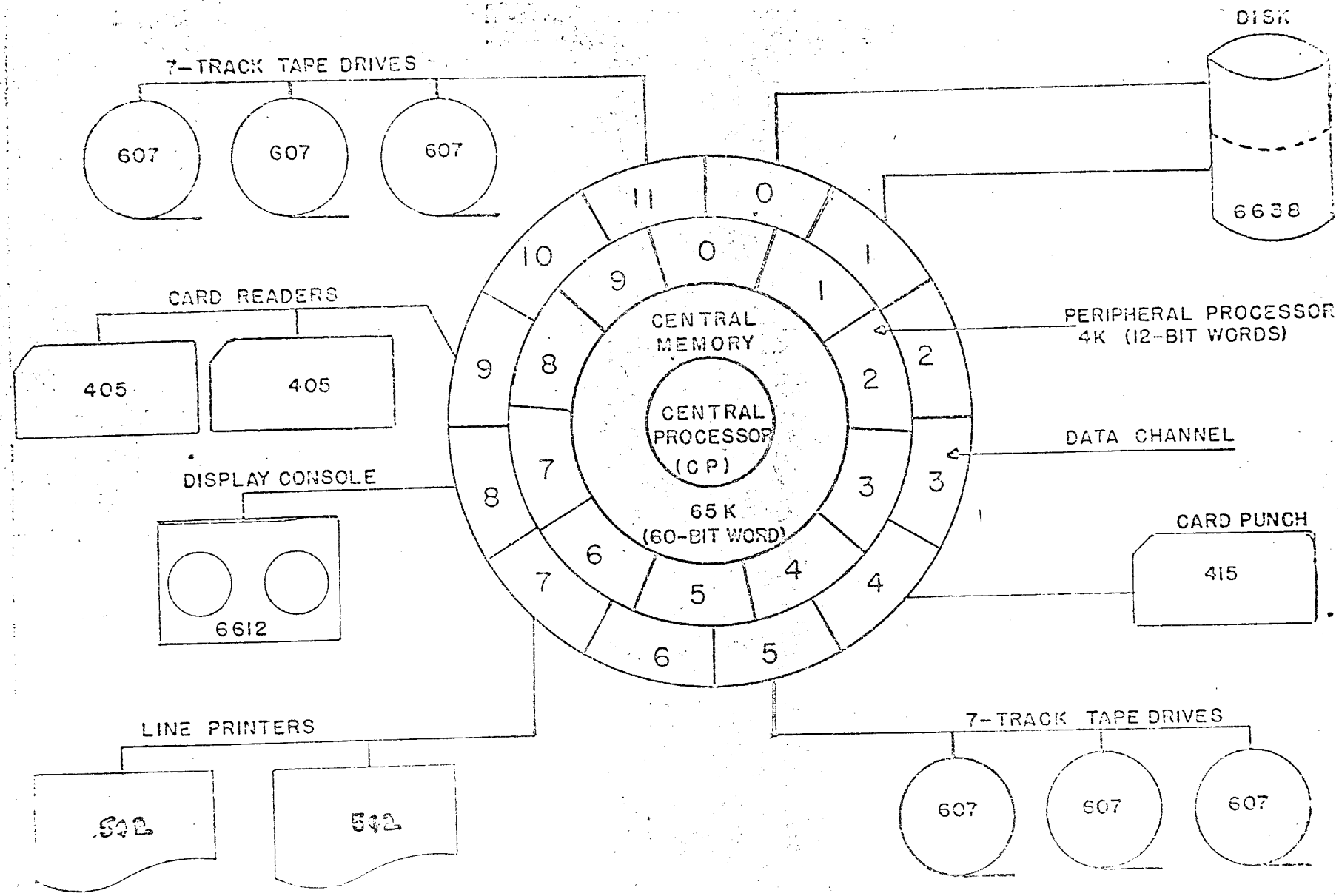
The B-5500 system configuration consists of 32 thousand words of storage, 28.8 million characters of disk, with a transfer rate of 100,000 characters per second. It has eight magnetic tape drives, two 1150-lines-per-minute printers, two 1400-cards-per-minute readers, one 300-cards-per-minute punch, one 100-characters-per-second paper-tape punch, and one 1000-characters-per-second tape reader. The system is also equipped with eight data sets to permit remote job-processing from ASR-Type 33 teletype machines located around the campus.

The CDC-6400 configuration is shown on the following page (C-2).

The B-5500 is normally operated three shifts per day, five days a week, with limited coverage from noon to 8 p.m. on the weekends. The CDC-6400 is operated twenty-four hours per day, seven days per week.

The Computer Center and the Computer Science Group are organizationally separate and are fulfilling different functions, but there are ties that provide constant and beneficial interaction between them. The director of the Computer Center has a joint faculty appointment in the Computer Science Group, and a number of Computer Science graduate students find part-time employment in the Center. Several Computer Science faculty members are on the Technical Advisory Committee of the Computer Center.

CHART 19 - CDC 6400 CONFIGURATION



Appendix D

COMPUTER SCIENCE LABORATORY

The Computer Science Laboratory (CSL) is the research and teaching laboratory for the Computer Science Group. The purpose of the facility is to provide training for students and to support computer science research projects. The facilities of the University Computer Center will continue to be used for those computer science projects that require extended production runs, the capabilities of a very large computer (CDC-6400), or which are intended to result in service packages to be offered to the University of Washington's general scientific community. The facilities of the Computer Science Laboratory are to be used for studies of operating systems and other studies which, if done on Computer Center equipment, might impede the job flow; and for studies which require specialized equipment (e.g. graphics terminals) which are not supported by the Computer Center. The criterion for research use of the Computer Science Laboratory is that each application must represent an advance in computer science. The facility is not available for computer support of other scientific projects that do not include a strong computer science component.

The operation of the Computer Science Laboratory is integrated with the graduate training program of the Computer Science Group in order to provide practical experience for those Computer Science students interested in the engineering and applied aspects of computer science.

The equipment was installed during Fall Quarter 1969, and is normally operated in foreground-background mode, with a large amount of time reserved for open-shop operation for experimental studies. The system can be considered to have three functional components. The computer is a Xerox Data Systems Sigma-5 with a disk-oriented operating system. The second component is the remote terminal system which provides for eight remote input-output stations for interactive computing. Initially, one of these is to be a graphic display station of the storage-tube type;

other such stations will be added in the future. The remainder will be conventional teletypes. The third major component which has yet to be installed, is an interactive graphic display system. Funds for this component have been budgeted, and procurement is proceeding at this time.

Initially, the Computer Science Laboratory will operate as a stand-alone computing system. It is planned that sometime in 1970 a remote terminal link will be completed with the University Computer Center's CDC-6400. This link is to be a prototype for other remote computer links and will permit the study of computer networks. The stand-alone facility of the CSL equipment will, of course, be retained for use when appropriate.

Taken together with the equipment of the Computer Center, the Computer Science Laboratory provides students and faculty in the Computer Science Group with the capability of doing research in virtually any phase of computer science.

Principal Units of the Computer Science Facility

1	8202	Sigma-5 CPU
1 3	8251 8252	Memory Units - 16^k words total
1	8273	Multiplexor I/O Processor
1	7202	RAD Storage (750,000 bytes, disk storage)
1	7232	RAD Storage (6 megabytes) to replace the 7202
2	7362	Magnetic Tape Units
1		Graphic Display

(Plus card equipment, line printer, keyboard, communication controllers, teletypes, etc.)

1	ARDS	Display System

APPENDIX E

GRADUATE STUDY IN MATHEMATICS

The Mathematics Department is one of the largest at the University of Washington , with over seventy faculty members and more than one hundred teaching and research assistants. Most fields of interest are represented. The department is especially strong in algebra, functional analysis, algebraic and general topology, probability, and statistics. Programs of study are offered leading to the following degrees:

Master of Arts (thesis and non-thesis programs)
Master of Arts for Teachers
Master of Science
Master of Science in Mathematical Statistics
Doctor of Philosophy

Graduate students working toward these degrees can take courses in almost all branches of modern mathematics: algebra; real and complex analysis; differential geometry; algebraic and general topology; probability and statistics; numerical analysis and applied mathematics, including computer science.

In addition to presenting formal course work in these areas, the faculty of the Mathematics Department is active in most areas of mathematical research. Graduate students working with the faculty have an early opportunity to pursue individual research and thesis work. The Mathematics Department offers a number of forms of support for graduate students. There are teaching assistantships, research assistantships, NSF traineeships, NDEA fellowships, and various other fellowships.

The following pages list current members of the Mathematics Department and their research interests. In addition, each year six to ten distinguished foreign mathematicians visit the department.

MATHEMATICS DEPARTMENT FACULTY 1969-70

ALLENDOERFER, CARL B., (1951), Professor (Leave Winter 1970, Spring 1970)
Oxford and Princeton, 1937
Differential Geometry and Topology

ARSOVE, MAYNARD G., (1951), Professor
Brown, 1950
Potential Theory, Complex Function Theory, Theory of Bases

AVANN, SHERWIN P., (1946), Associate Professor
CIT, 1942
Lattice Theory

BEAUMONT, ROSS A., (1940), Chairman and Professor
Michigan and Illinois, 1940
Algebra (Abelian groups, Ring theory)

BIRNBAUM, Z. WILLIAM, (1939), Professor
Lwow (Poland), 1929
Probability, Mathematical Statistics (current special interest: distribution-free statistics, reliability-theory)

BLUMENTHAL, ROBERT M., (1956), Professor
Cornell, 1956
Probability Theory (Markov Processes)

BROWNELL, FRANCIS H., (1950), Professor
Yale and Princeton, 1949
Spectral Analysis of Hilbert Space Operators, Mathematical Quantum Mechanics, Partial Differential Equations

BUNGART, LUTZ, (1966), Associate Professor
Princeton, 1962
Analysis (several complex variables)

CHAN, YUEN KWOK, (1969) Assistant Professor
University of California, San Diego
Probability Theory

CHAPMAN, DOUGLAS G, (1949), Professor
California, 1949
Statistics, Biometrics

CLEMENTS, JOHN C. (1969), Instructor
University of Toronto, 1969
Partial Differential Equations

CORSON, HARRY H., (1958), Professor
Duke, 1957
Topology and Functional Analysis

CURJEL, CASPAR R., (1964), Professor
ETH, Zurich, 1960
Algebraic topology, Algebra

DEKKER, DAVID B., (1948), Associate Professor
Berkeley, 1948
Numerical Analysis, Applied Math., Metric Differential Geometry

DUBISCH, ROY, (1961), Professor
Chicago, 1943
Teacher Training: elementary and secondary curriculum

DUKE, RICHARD A., (1965), Assistant Professor
Dartmouth and Virginia, 1965
Topological graph theory

FISHER, LLOYD D., (1966), Assistant Professor
Dartmouth, 1966
Probability theory

GANEA, TUDOR, (1963), Professor
Bucharest and Paris, 1962
Homotopy theory and Geometric topology

GANGOLLI, RAMESH A., (1962), Professor
MIT, 1961
Probability theory, Harmonic analysis on Lie groups

GLICKFELD, BARNETT, (1967), Assistant Professor (On leave 1969-70)
Columbia, 1964
Function algebras

GLICKSBERG, IRVING L., (1962), Professor
California (L.A.), 1951
Functional and Harmonic Analysis

GOLDSTEIN, ALLEN A., (1964), Professor
Georgetown, 1954
Approximation theory, non-linear programming, control theory, calculus of variations.

GRUNBAUM, BRANKO (1966), Professor (On leave 1969-70)
Hebrew University, 1957
Geometry

HACKMAN, MORTON M., (1963), Assistant Professor
Chicago and M.I.T., 1963
Functional Analysis and Differential Equations

HALLSTROM, ALFRED, (1969), Assistant Professor
Brown University, 1968
Function Algebras, Rational Approximation

HANDEL, DAVID (1968), Assistant Professor
Chicago, 1965
Algebraid Topology

HEWITT, EDWIN, (1948) Professor (Leave Fall 1969, Winter 1970)
Harvard, 1942
Harmonic analysis on groups, Measure theory, Functional analysis

HIRSCHFELDER, JOHN J., (1968), Assistant Professor
Notre Dame, 1968
Several Complex Variables

HOBBY, CHARLES R., (1961), Associate Professor
CIT, 1960
Finite groups, Combinatorial problems

HOSAY, NORMAN, (1964), Assistant Professor
Wisonsin, 1963
Point set topology of Euclidean Spaces and Manifolds

HUNGERFORD, THOMAS W., (1963), Associate Professor (Leave 1969-70)
Chicago, 1963
Homological algebra

JANS, JAMES P., (1957), Professor
Michigan, 1955
Ring structure and Homological algebra

JOHNSON, HAROLD H., (1961), Associate Professor
Berkeley, 1957
Exterior differential systems, Systems of partial differential equations, Invariance under groups and Pseudo-groups of transformations

KINGSTON, JOHN MAURICE, (1940), Executive Secretary;Associate Prof.
Toronto, 1939
Math Education (Secondary)

KLEE, VICTOR L., (1953) Professor
Virginia, 1945
Convex sets, Functional Analysis, Point-set topology, Linear programming, Combinatorics.

KNUDSON, DAVID (1967), Assistant Professor
Northwestern, 1967
Algebra

KOZLOWSKI, GEORGE A.,Jr., (1969) Assistant Professor (Leave 1969-70)
Michigan, 1968
Geometric, algebraic, and general topology

LUMER, GUNTER, (1961), Professor
Chicago, 1959
Function algebras (analytic functions and harmonic analysis)
Functional Analysis

LUMER, LINDA (1961), Acting Associate Professor
Paris, 1957
Potential theory and applications, Axiomatic theory of harmonic functions; partial differential equations, and boundary behavior of solutions; Axiomatic extension of classification of Riemann surfaces

McANDREW, MICHAEL H., (1964), Assistant Professor
Trinity College, Cambridge, 1959
Graph theory, Number theory

MICHAEL, ERNEST A., (1953), Professor
Harvard and Chicago, 1951
General Topology

MONK, GEORGE S., (1964), Assistant Professor (On leave 1969-70)
Minnesota, 1965
Lattice Theory

MOORE, ROBERT T., (1968), Associate Professor
Princeton, 1964
Function Algebras and Functional Analysis

MOREL, ANNE C., (1960), Associate Professor
Berkeley, 1953
Logic (model theory), General algebra, Ordered groups

MORROW, JAMES, (1969), Assistant Professor
Stanford, 1967
Complex Analysis

NAMIOKA, ISAAC, (1963), Professor
Kansas and Berkeley, 1956
Algebraic topology, Functional analysis

NUNKE, RONALD J., (1958), Professor
Chicago, 1955
Category theory, Abelian groups

O'KEEFE, KATHLEEN, (1969), Lecturer and Academic Counselor
University of California, Berkeley, 1959
Biostatistics, Teacher Education

OZOLS, VILNIS (1968), Assistant Professor
Berkeley, 1967
Lie Groups, Riemannian Geometry

PEARSON, CARL (1968), Professor
Brown, 1949
Applied Mathematics

PHELPS, ROBERT R., (1962), Professor (On leave 1969-70)
Washington, 1958
Convexity, extreme point problems, abstract best-approximation

PIERCE, RICHARD S., (1955), Professor
CIT, 1952
Algebra

PINCUS, DAVID F., (1969), Instructor
Harvard, 1969
Logic and Set Theory

PYKE, RONALD (1960), Professor
Washington, 1956
Probability (Renewal theory and Markov chains) and Statistics (Non-parametric inference)

RAGOZIN, DAVID, (1969), Assistant Professor
Harvard, 1967
Approximation Theory on Groups and Manifolds

REMENSCHNEIDER, SHERMAN, (1969), Instructor
Syracuse, 1969
Functional Analysis and Approximation Theory

RICHARDSON, ROGER W., (1960), Professor (On leave 1969-70)
Michigan, 1958
Lie groups, Lie algebras, algebraic groups

RITCHIE, ROBERT W., (1962) Associate Professor
Princeton, 1961
Logic, Recursive Functions, Mathematical Linguistics

RITTER, WILLIAM E., (1964), Assistant Professor (On leave 1969-70)
MIT, 1962
Logic and Recursive Function Theory

ROBERTSON, LEWIS C., (1965), Assistant Professor
Chicago and UCLA, 1965
Topological groups, Lie groups, infinite-dimensional representations

ROCKAFELLAR, R. TERRY, (1966), Associate Professor
Harvard, 1963
Convexity, Linear Programming

SARASON, LEONARD, (1965), Associate Professor (On leave Fall 1969 Winter 1970)
New York University, 1961
Partial Differential Equations

SEGAL, JACK, (1960), Associate Professor (On leave 1969-70)
Georgia, 1960
Topology

SHORACK, GALEN R., (1965), Assistant Professor (On leave 1969-70)
Oregon and Stanford, 1965
Math Statistics (Distribution free statistics)

SMYTHE, ROBERT, (1969), Instructor
Oxford, 1969
Probability Theory

STOUT, EDGAR LEE, (1969), Associate Professor
University of Wisconsin, 1964
Functions of a Complex Variable; Riemann Surfaces, function algebras; Functional Analysis

THOMAS, GOMER (1969), Assistant Professor
Illinois, 1968
Theory of finite groups

TROY, ALAN (1962), Assistant Professor
Illinois, 1961
Representations of finite groups

VAN NESS, JOHN W., (1966), Assistant Professor
Brown, 1964
Probability and Statistics

WARFIELD, ROBERT B., (1968), Assistant Professor
Harvard, 1967
Algebra

WARNER, GARTH W., (1966), Associate Professor
Michigan, 1966
Analysis

WHYBURN, KENNETH G., (1966), Assistant Professor
Cornell, 1965
Analysis

WOOLF, WILLIAM B., (1959), Associate Professor (On leave 1969-70)
Michigan, 1959
Complex Variables, particularly boundary behavior
Also teacher training.

WULBERT, DANIEL, (1967), Assistant Professor
Texas, 1966
Functional Analysis, Approximation Theory

ZUCKERMAN, HELEN C., (1952), Lecturer
Washington, M.S. 1935
Correspondence and Extension Classes

ZUCKERMAN, HERBERT S., (1939), Professor
Chicago and Berkeley, 1936
Elementary Number Theory

VISITING FACULTY 1969-70

Name, rank, regular position, and area of mathematical interest are included in that order for each visiting faculty member in our department.

GRUNENFELDER, LUZIUS, Visiting Lecturer
Researcher in Mathematics, Battelel Institute, Geneva
Algebra, Analysis, Theoretical Physics

HACKENBROCH, WOLFGANG, Visiting Lecturer
Assistant, Mathematics Institute, Saarbrucken
Measure Theory

HERING, FRANZ, Visiting Scholar
Assistant, University of Bonn
Convex Polytopes

LEUTWILER, HEINZ, Visiting Lecturer
Assistant, Swiss Federal Institute of Technology
Potential Theory and Subharmonic Functions

McCRUDDEN, MICHAEL, Visiting Lecturer
Lecturer, University of Birmingham
Probability Theory

NOBLE, NORMAN L., Visiting Assistant Professor
Assistant Professor, Clark University
General Topology

OPPELT, JOHN, Visiting Assistant Professor
Assistant Professor, University of Virginia
Abelian Groups

SESHU, LILY, Visiting Scholar
Assistant Professor, Portland State University
Analysis

SINGH, VASHISHTHA, Battelle Research Instructor
Research Assistant, University of California, Berkeley
Kernel functions on Hilbert Space, Differential Geometry

TZAFRIRI, LIOR, Visiting Lecturer
Visiting Assistant Professor, Northwestern University
Functional Analysis

WIK, INGEMAR, Visiting Lecturer
Docent, Umea University
Fourier Analysis

ZIZLER, VACLAV, Visiting Scholar
Assistant Professor, Charles University in Prague
Linear and non-linear functional analysis

Appendix F

DEPARTMENT OF ELECTRICAL ENGINEERING

University of Washington

The Department of Electrical Engineering at the University of Washington numbers 41 faculty members and approximately 700 students, 200 of the latter being graduate students. The research program of the department is closely tied to the educational program, and most of the research is conducted by students working on their degree requirements in close coordination with the responsible faculty member.

Currently, the professional and research interests of the faculty include the following:

1. Solid-state materials and devices. Six faculty members are engaged in research in this area, with programs in magnetic resonance, ferroelectrics, solid-state plasmas, instabilities in semiconductors, avalanche breakdown processes, and low-temperature semiconductor operation.

2. System theory. Ten of the faculty are engaged in this broad area, with programs in suboptimal system design, PFM control systems, biological control system studies, stability theory, optimization techniques, pattern recognition, detection theory, and power systems.

3. Radioscience. Four faculty members are engaged in this program which includes some joint effort with the Geophysics group. Two major projects are included, one devoted to the study of low frequency propagation to and from the Antarctic, and the second concerned with atmospheric coupling of radio signals at a variety of frequencies. The field station in the Antarctic is manned year-round, and its major antenna is a 21-mile wire laid on the ice for effective VLF coupling.

4. E & M theory, acoustics, and optics. Nine of the faculty are involved in this area, which includes studies of optical propagation, antenna theory, propagation through turbulent media, optical surface waves, fiber optics in biological instrumentation, medical applications of ultrasound, optical data processing, and radiation patterns in magnetically active media.

5. Computers. Seven faculty members are in this area, which is closely allied with the computer science group. Research topics include computer languages and their grammars, learning models and heuristic methods, and logical design.

6. Electronics and circuits. Many of the faculty are involved in the electronics area, with programs in network theory, switching circuits, and electronic design.

7. Bioengineering. This is an interdisciplinary program, making use of the professional engineering talents from many of the above listed areas. Ten of the faculty are involved with bioengineering programs, in general through exercise of a specific engineering discipline such as ultrasonics, system theory, or optical techniques.

8. Ocean Engineering. Three of our faculty are engaged in work in this area, mostly related to signal processing and data interpretation.

The department issues a report annually which gives more detail on research programs. Further information may be obtained from the department office.

The Department of Electrical Engineering is housed in its own building which is currently being expanded from four floors to five. In addition to the normal educational facilities, the building contains a solid-state materials and devices research laboratory, an optics laboratory, a microwave laboratory, computing facilities, complete machine shops (one for shop personnel and one for general use), and assorted specialist laboratory space as required. A

microwave anechoic chamber 200 feet long and a controlled atmosphere lab are under construction. The department is also responsible for a radio propagation laboratory located in West Seattle, and participates in interdisciplinary research programs with excellent facilities in other buildings, such as bioengineering, Ocean Engineering, and the Aerospace Research Laboratory.

ELECTRICAL ENGINEERING DEPARTMENT FACULTY 1969-70

lexandro, Frank J.	Assoc. Prof.	Control Systems
ncker-Johnson, Betsy	Affiliate Prof.	Solid State Electronics
ndersen, Jonny	Asst. Prof.	Circuits, Systems, Computer Aided Design
uth, David C.	Asst. Prof.	Optics & Solid State
aer, Jean L.	Asst. Prof.	Computer Science
ergseth, F. Robert	Prof.	Power Systems & Automatic Control
jorkstam, John L.	Prof.	Materials Science & Solid State Devices
arlson, F. Paul	Asst. Prof.	Optics, Electromagnetics, Lasers, Bioengineering
lark, Robert N.	Prof.	Automatic Control Systems
reedon, William E.	Lecturer	Machinery
amborg, Mark J.	Asst. Prof.	Control Systems
ow, Daniel G.	Prof., Chrmn.	Solid State Electronics, Department Chairman
uff, Graham L.	Asst. Prof.	E.M. Theory, Plasmas
olde, Hellmut	Prof.	Computer Science, Microwave Tubes
ilford, Edward C.	Assoc. Prof.	Electromechanical Systems, Digital Systems, Nonlinear Magnetics
arris, Jay H.	Asst. Prof.	Biomedical & Optical Electronics, Electromagnetics
arrison, Arthur E.	Prof.	Microwaves, Propagation
elms, Ward J.	Asst. Prof.	Radio Science & Geophysics
ill, W. Ryland	Prof.	Electronic Circuits
olden, Alistair D. C.	Asst. Prof.	Digital Computers, Logical Design & Applications
su, Chih-Chi	Assoc. Prof.	Control Systems & Cybernetics
shimaru, Akira	Prof.	Electromagnetic waves, Waves in Random Media, Optics, Bioengineering

Johnson, Curtis C.	Assoc. Prof.	Bioengineering (Electromagnetics, Optics)
Johnson, David L.	Prof.	Computer Applications & Modelling, Logical Design of digital systems
Lauritzen, Peter O.	Assoc. Prof.	Solid State Electronics
Lewis, Laurel J.	Prof.	Computer Applications & Network Synthesis
Lytle, Dean W.	Prof.	Communication & Information Theory
Martin, Richard D.	Asst. Prof.	Communication Theory
Metz, Peter R.	Asst. Prof.	Communication Theory & Optics
Noe, Jerre	Prof.	Computer Science
Noges, Endrik	Prof.	Nonlinear & Discontinuous Control Systems
O'Keefe, Kenneth H.	Asst. Prof.	Computers
Peden, Irene C.	Assoc. Prof.	Electromagnetics, Application of Microwave Techniques to Geophysical & Bioengineering Problems
Pinter, Robert B.	Asst. Prof.	Bioengineering, Control Systems
Reynolds, Donald K.	Prof.	Applied Electromagnetics, Electronic Systems
Robbins, Floyd D.	Assoc. Prof.	Electro-nuclear & E.H.V. Electrical System Analysis
Rogers, Walter E.	Prof.	Electromagnetics
Schibli, Eugen G.	Asst. Prof.	Semiconductors
Sigelmann, Rubens A.	Assoc. Prof.	Electromagnetics, Acoustics, Bioengineering
Swarm, H. Myron	Prof.	Antennas, Radio Science, Probability & Geophysics
Yee, Sinclair S.	Asst. Prof.	Solid State Electronics

APPENDIX G

UNIVERSITY OF WASHINGTON
SEATTLE, WASHINGTON 98105

Office of the Vice President
for Academic Affairs and Provost

March 2, 1970

National Science Foundation
Washington, D.C. 20550

Gentlemen:

In re University of Washington Proposal for Development of Computer Science

As an indication of continuing University interest in development of its Computer Science program, and as an aid to coordination of funding should the proposed support for faculty positions be granted, it is the intent of the University to fund new Computer Science positions on approximately the following schedule:

Starting Autumn Quarter	Number of New Positions
1970	1
1971	1
1972	1
1973	2
1974	1

This assumes, of course, and is conditioned upon, anticipated legislative budget appropriations for the relevant biennia.

It is the belief of the concerned administrative officers of the University that this rate of faculty addition, in conjunction with the additions requested through National Science Foundation funds, will provide a feasible and highly desirable development program.

Sincerely yours,

Solomon Katz
Vice President for Academic
Affairs and Provost

SK:mkb

Appendix H

UNIVERSITY OF WASHINGTON ENGINEERING LIBRARY

A recent decision within the University of Washington Library systems selected the Engineering Library as the focal point for the collection in computer science.

The Engineering Library houses over 40,000 books, subscribes to more than 1200 periodicals, maintains a technical report collection of over 150,000 items, and provides intensive and current coverage of the diverse areas of engineering. It is housed in a new four-story building containing the circulation desk, catalog and reference service, reserve area, browsing rooms, periodical catalog, and technical report catalog. The basement area contains typing carrels and a photocopy room for instant copy service. Microfilm readers and typewriters are also located on the upper floors.

The Engineering Library is a depository for all Atomic Energy Commission and National Aeronautics and Space Administration publications.

The Engineering Library has special strength in the areas of applied mathematics, applied physics, nuclear physics, biophysics, aeronautics, ocean engineering, and solid state electronics. It has a good collection in the computer science field, covering a large proportion of the most commonly used references, but the collection does need further expansion.