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RECOMMENDATIONS FOR IMPROVING COMPUTER-SCIENCE EDUCATION IN BRAZIL

Summary Report of the NAS-CNPq Study Group on

Computer-Science Education in Brazil

Rio de Janeiro, Brazil

10 - 15 December 1971

Jointly Sponsored by the
Conselho Nacional de Pesquisas
Brazil

and the

National Academy of Sciences
United States of America

This report is a summary of the meeting of the Joint Study Group on Computer Sciences held in Rio de Janeiro, December 10 - 15, 1971, co-sponsored by the Board on Science and Technology for International Development, Office of the Foreign Secretary of the National Academy of Sciences, and the Conselho Nacional de Pesquisas. It contains recommendations for the strengthening and orderly development of computer-science education in Brazil. The report is submitted to the Agency for International Development under contract AID/csd-1122, Task Order 3.

NOTICE

The study reported herein was undertaken under the aegis of the National Academy of Sciences with the express approval of the Governing Board of the National Academy of Sciences - National Research Council. Such approval indicated that the Board considered that the problem is of national significance; that elucidation and/or solution of the problem required scientific or technical competence and that the resources of NAS were particularly suitable to the conduct of the project. The institutional responsibilities of the Academy were then discharged in the following manner:

The members of the study committee were selected for their individual scholarly competence and judgment with due consideration for the balance and breadth of disciplines. Responsibility for all aspects of this report rests with the study committee, to whom sincere appreciation is expressed.

Although the reports of our study committees are not submitted for approval to the Academy membership nor to the Council, each report is reviewed by a second group of appropriately qualified individuals according to procedures established and monitored by the Academy's Report Review Committee. Such reviews are intended to determine, inter alia, whether the major questions and relevant points of view have been addressed and whether the reported findings, conclusions, and recommendations arose from the available data and information. Distribution of the report is approved by the President only after satisfactory completion of this review process.

PREFACE

The joint study group activities leading to this report on computer-science education in Brazil were part of a larger program to consider the application of science and technology to Brazilian economic development, sponsored jointly by the Brazilian National Research Council (CNPq) and the National Academy of Sciences (NAS): The First Brazil - U.S. Workshop on "The Role of Science and Technology in Economic Development" was held in 1966; the Fourth, and most recent, in November, 1971.

CNPq's early recognition of the impact of the rapid expansion of computer usage on the Brazilian economy led to an examination of computer sciences at the Second Brazil - U.S. Workshop, February, 1968. A workshop recommendation calling for a preliminary study of existing computer facilities and future needs was implemented by a two-man team in September, 1968.

Next, in April, 1969, at the Third Workshop, the conclusions of the preliminary study were presented: The importance of computers in Brazil was unmistakable and the need for formulating policy urgent. The workshop then recommended that a joint study group be formed to examine the immediate and projected requirements for trained scientists and technicians in computer sciences and to recommend policies to fill these needs.

In May, 1970, two members of the CNPq panel visited computer facilities and examined academic programs at eight major institutions across

the United States. Shortly thereafter, the NAS panel of four was selected and the first joint study group meeting scheduled for August 10-14, 1970, in Brazil.

The main objective of the study group meeting was to gather data on all facets of computer technology in Brazil: the number and size of computers installed or purchased; the major applications of computers; the average number and educational background of professionals and technicians associated with computer facilities; the number of universities with either degree programs in computer sciences or computer centers that offer service to university administrations or science and engineering departments.

Following the study group meeting, the NAS panel drafted a working paper which formed the basis for subsequent discussion and identification of priorities. The result of these discussions was a decision to focus the group's attention, first, on the constraints to the development of undergraduate and graduate education in computer sciences and, second, on the relationship between the universities and industry. Toward this end, the Brazilian panel provided detailed descriptions of existing graduate programs in three Brazilian universities. (See Appendix.)

The two documents served as the focus of discussion on computer sciences at the Fourth Brazil - U.S. Workshop, as well as at a brief study group meeting held immediately before the workshop. The workshop recommended further examination in detail of data on the three graduate programs with the objective of elaborating recommendations for strengthening and stimulating effective planning and coordination among them. Strengthening of undergraduate programs was also to be considered. In addition, the

study group was to consider further the joint university - industry development of human resources and determine the applicability of its experience and findings to the planned "Rio Symposium on Computer Science Education in Developing Countries," August 6 - 12, 1972. The following reports the conclusions of the third joint study group meeting on computer sciences held in Brazil, December 10 - 15, 1971.

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RECOMMENDATION I:

IMPROVING THREE MAIN EXISTING COMPUTER-SCIENCE PROGRAMS

The CNPq-NAS joint study group recognizes the advantages of quickly establishing in Brazilian universities a small number of Ph.D. programs in computer science; it also recognizes the problems involved in such an effort. A Ph.D.-producing department must have a significant number of faculty members who are engaged in research. Indeed it is the reputation of the faculty members' research that largely determines the "reputability" of the Ph.D.'s awarded. Generally, a critical number of people is required for any research group to be viable long enough for candidates to be attracted, attend, and graduate. In the three major Brazilian universities* planning to offer Ph.D. programs in computer science, the faculty resources are barely at, or possibly below, minimum needs in terms of numbers and backgrounds of professors engaged in research. Considerable effort must be given to upgrading the present faculties and enlarging them either by permanent additions or by a steady stream of long-term visitors.

A. VISITING FOREIGN EXPERTS

Each of the three major universities* should plan for the continuous presence of foreign experts in computer science.

1. These individuals, recognized experts in their areas of specialization, should undertake minimum assignments of 1 year. For academic

*Catholic University of Rio de Janeiro (PUC), Federal University of Rio de Janeiro (COPPE), and the University of São Paulo (USP).

purposes initial periods of less than 1 year are not satisfactory, since they do not permit foreign experts to become sufficiently well acquainted with local conditions and to establish working relationships with their local colleagues. Periods longer than 1 year would be desirable, but leaves of that duration are not usual in U.S. universities. On the other hand, experts with administrative experience may be able to contribute in significant ways for shorter periods.

2. An expert from abroad should be selected only after a local group has been identified who can work with him and sustain the activity after he leaves. To insure survival of the activity, every effort should be made to obtain a commitment for periodic (annual) 3- to 4-week return visits for several years after the initial period.

3. The visiting experts should be used (1) to head research groups in their areas of specialty, (2) to present seminars and help with Journal Clubs (weekly summaries of current literature), (3) to advise on curricula, (4) to help evaluate research activities of graduate students and junior staff, and (5) to consult on organization problems related to computers.

4. Some visitors may wish to bring graduate students to assist and continue their work. This practice should be encouraged, since these graduate students would increase communication with local students.

5. Since the intent is to improve the quality of graduate programs and research, the visitors should be encouraged to be outspoken wherever constructive criticism is possibe.

6. Since Brazilian salaries for senior people will average less

than two thirds of American salaries--and the cost of living for a foreigner is not much less than that at home--extra funds must be found to pay for travel, income tax inequities, etc. In general, such programs should be planned on the basis of no-loss, no-gain to the participant.

B. SUMMER INSTITUTES

It is recommended that Summer Institutes be held on a rotating basis among the three universities--PUC, COPPE, and USP--with the participation of the whole computer community.

1. These Summer Institutes should run from 3 to 4 weeks every year, their main purpose being to exchange information on computer-science research and teaching within the framework of intensive courses and seminars on specific subjects. Participation in these Summer Institutes of the coordinators of the graduate courses of the three major institutions is very important to their becoming more effective in evaluating and planning their graduate programs.

2. To improve other institutions (see Recommendation II), as well as the major universities, Summer Institutes should be held on two levels. One level should treat the more advanced aspects of research and teaching, specifically in the major institutions. This level would provide an opportunity to bring highly qualified persons from abroad who would be unavailable for longer periods to talk about their research and to teach advanced courses. It would also provide an opportunity for faculty and students from the major institutions in Brazil to speak about their own research and teaching. This exchange of information should stimulate research and provide a basis for evaluating current work.

3. A second level of Summer Institutes, using qualified Brazilian staff from universities and industry and occasional foreign experts, would treat similar problems in computer science but at a level more consistent with the short- and medium-range needs of the attendees. These sessions would be more tutorial than those on the other level.

4. The foreign specialists should be carefully selected, in terms of maintaining continuity of subject matter and increasing the breadth of computer-science activity. The intent is to use Brazilian past experience and to open up new areas of activity. The Summer Institutes would provide an excellent opportunity for foreign experts who had previously worked in Brazilian universities to return to follow up on the activity with which they had been involved.

5. The selection of the attendees should also be carefully planned to give an equal opportunity to scientists and technicians from any Brazilian institution.

6. The financing of Summer Institutes, as well as the attendees' expenses, should be in the form of grants and scholarships from a Brazilian government source.

7. It is understood that the Summer Institutes are a complementary activity to regular annual programs. Panel sessions could be used to evaluate the regular programs and the Summer Institutes themselves.

C. CONTINUING OVERSEAS TRAINING

Improving graduate programs in the major institutions should not be allowed to interfere with continuing the existing overseas training program.

1. Existing Brazilian programs, even with the recommended improvements, will not cover the whole spectrum of computer science. Therefore, a student looking for research in an area not covered by the programs should be encouraged to go abroad. To broaden the scope of computer-science activities (and to minimize inbreeding), postdoctoral research abroad should be encouraged, especially for the graduates of Brazilian institutions.

RECOMMENDATION II:

IMPROVING THE TEACHING OF COMPUTER SCIENCE IN OTHER UNIVERSITIES

It is recommended that (A) every effort be made to upgrade faculty in computer science, (B) academic programs in computer science and business data processing be encouraged, (C) service-oriented computer centers be developed, and (D) the flow of technical information be improved.

Although the main objective of the proposed support program is to build up computer science in the three universities (PUC, COPPE, and USP), it is essential that strong support also be provided to improve computer science and related subjects in other institutions. Students' demands for such study programs and industry's needs for computer-science and data-processing graduates are so heavy that these three universities cannot possibly satisfy them. As stated previously, the joint study group considers these three universities the major source for staffing the other Brazilian universities, which, in turn, should prepare graduates for industry and government.

A. FACULTY UPGRADING

The teaching and research capabilities of the other institutions in computer science and related fields must be strengthened by

1. Summer Institutes, as described under I.B. above.

2. Exchange of personnel with PUC, COPPE, and USP. Faculty members from these three universities should be encouraged to spend a

week to a semester in other institutions, teaching advanced courses or consulting with the faculty. Faculty from the other institutions should be encouraged and supported to study, and perhaps teach, at the three universities.

3. Support and encouragement of faculty visitors from abroad. Such visits are beneficial only when they are of sufficient duration and the host institution has a faculty prepared to profit from them.

4. Graduate studies abroad. Qualified faculty members should be encouraged and supported in their pursuit of graduate studies abroad at both the M.S. and the Ph.D. levels.

B. ACADEMIC PROGRAMS

Academic programs in computer science and related subjects should be encouraged along the following lines:

1. Computer-science activity will generally start with "service courses" that teach numerical analysis and the "art" of computing to students in engineering and in the quantitative sciences. Extending specific areas of computer science into graduate programs should occur only if there is adequate and qualified staff. This extension may well occur in conjunction with the establishment of a "pairing relationship" with one of the three main universities.

2. Specialized programs should be encouraged, taking full advantage of faculty strengths and seeking to avoid duplication with other programs. Basic and service courses must be included. Where possible, data-processing courses should be encouraged, often utilizing part-time lecturers recruited from industry.

C. COMPUTER CENTERS

Strong service-oriented computer centers must be developed.

1. Computer centers should be supported or upgraded in those institutions that have demonstrated both their need and their competence. A considerable potential for increased computer usage exists in many Brazilian universities which should be filled, not by an immediate influx of large machines, but by upgrading those centers that have already demonstrated that they can exploit the available small machines. Upgrading must not be confined to equipment, but must include staff in other supporting services.

2. Highest priorities for computer availability should be allocated to teaching and academic needs, as opposed to administrative work. Administrative use can be scheduled so as not to conflict with academic use. Development of administrative programs can be mixed in the job stream with no difficulty. Production can occur late at night when academic use is at a minimum.

3. Funds for purchasing equipment, personnel, supplies, etc.--and for computer-center operating expenses--should be allocated as a line item in the annual university budget. The panel unanimously feel that general academic use of computers should be considered part of the overall cost of running the university and not subject to fluctuating contract support. Many U.S. universities have had serious problems because they tried to fund their academic use of computers through research contracts and the like. Unlike university libraries, which are funded out of general university funds, computing centers have often been forced to scramble

for contract funds. When these were readily available, academic programs benefited, but, when contract funds dwindled, so usually did the academic programs.

4. Because computing plays a major part in many academic programs, those institutions lacking a computer should be given access to one, through courier service, terminals, or teleprocessing. Access to a machine is clearly essential in computer-science courses and equally necessary in many other courses and areas of research. Computer courses given without practical experience on actual computers are of little value. Although the long "turn-around" of courier service is undesirable, it is far better than no practical experience at all.

D. PROFESSIONAL STRENGTH

Faculty and students must be given every opportunity to keep up with the latest developments in the field.

1. An adequate library, including both books and periodicals, is essential. Library funds should be provided as line items in the annual university budget. Acquisition lists of the main libraries should be available to other institutions. Preprints and reports in areas of special interest can be obtained through "Pairing" contracts established with foreign institutions. Xerox, microfilm, or microfiche copies of reports are available from University Microfilms* or the National Technical Information Services.**

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*University Microfilms, Ann Arbor, Michigan.

**National Technical Information Services, National Bureau of Standards, Springfield, Virginia 22151.

2. Translation of elementary and more advanced classic texts should be strongly supported. Various academic departments interested in computer science in Brazil might select a modest number of English-language texts that they think should be translated into Portuguese. They should then approach a commercial publisher with the commitment that a significant percentage of the universities will use these texts. This modus operandi should work for the more popular texts, but the translation of more advanced books may require a subsidy. Here again, it is recommended that the publication and sale be handled commercially. Industry should be encouraged to help subsidize this activity.

3. National computer meetings in Brazil should be strongly supported as they provide a major platform for individuals to present their own work under the critical eye of colleagues.

RECOMMENDATION III:

RESPONSIBILITIES OF THE UNIVERSITIES AND INDUSTRY

A. TRAINING PEOPLE FOR INDUSTRY

It is recommended that universities and industry cooperate in educational and training activities.

The universities are responsible for educating students in the broad area of computing; industry should provide training in specific applications. Coordination of these two efforts is essential to minimizing overlap or gaps.

In the long term, the teaching and training resources of the univsities and industry must be balancedon the basis of the needs of both groups. However, the present conflicting demands on scarce resources, especially highly trained manpower, can be expected to continue for several years. Therefore, the universities and industry must each recognize the responsibilities and needs of the other: e.g., raiding of people should be avoided, and experts should be shared whenever appropriate.

Industry and government should recognize and begin to prepare now for the serious problem of continuing education, perhaps via a pilot program of sending staff members back to school for a sabbatical semester or year, or through extension programs. Otherwise, in a few years, Brazil will be faced with a situation similar to that now existing in the United States, where there are many "badly outdated" computer people.

The following short- and long-term projects are all important, and each should be attempted to the extent that resources are available.

The recommended short-term projects are:

1. Present university faculty members in computer sciences should make themselves available as consultants to industry and to other university departments interested in establishing computer-related courses.

2. University extension courses should be expanded with assistance from experts working in industry and government.

3. Existing university computer centers should immediately arrange for facilities for running business-oriented languages, such as COBOL and PL/I. These facilities should, wherever possible, be equivalent to those available for FORTRAN.

4. CNPq should support the surveys of computer usage in Brazil by the Association of Users of Electronic Computers and Subsidiary Equipment (SUCESU), since surveys are basic to all planning activities.

5. Industry should help finance courses oriented toward data processing in business schools, economics departments, etc.

6. University and industry personnel should work with the ministries of labor and education to study the possible certification of people in the computing field, with attention to the problems of protecting confidential information. Drawing from our U.S. experience, we see the time coming when public institutions and the public will insist on computerized systems being built, or at least approved, by someone of known competence This is a very complicated area and one which the United States has not yet resolved. However, it is not too early for the question to be raised and discussed in Brazil.

Following are the recommendations for long-term projects:

1. Industry must recognize that strong university computer-science departments are essential for a long-term supply of well-trained manpower for industry. Initially, most of the graduates of the three major universities will, we hope, teach at other universities, thus upgrading those university programs.

2. Business-oriented academic departments must organize courses around computers to introduce all their students to this powerful tool. This is especially important in departments such as business administration, economics, industrial engineering, public administration, etc.

3. University computer centers should provide enough capability to service the needs of all interested departments (those oriented toward business and technology, as well as the sciences).

RECOMMENDATION IV:

SUPPORT FOR AUGUST, 1972, RIO SYMPOSIUM ON COMPUTER EDUCATION FOR DEVELOPING COUNTRIES

A. THE RIO SYMPOSIUM

The joint study group should participate in the organization of the Rio Symposium on Computer Education for Developing Countries, to be held August 6 - 12, 1972. The joint study group is in a position to contribute to the success of the symposium and to further its objective, namely, to formulate recommendations and plans for maximizing the effectiveness of computer-science education in Brazil.

The idea for the Rio Symposium was presented at the Conference on Computers for Developing Countries held in Jerusalem in August, 1971, attended by four members of the joint study group. Subsequently, the Rio Symposium has found widespread endorsement from international organizations and other developing countries. The host organization is the Brazilian Academy of Sciences in conjunction with the Intergovernmental Bureau for Informatics of the International Computation Center in Rome. In addition, a number of the official co-sponsors include The International Federation of Information Processing Societies (IFIPS), UNESCO, OAS, and the Brazilian SUCESU.

The Joint Brazil - U.S. Workshop on Science and Technology in Development, held in Washington, D.C., November 1 - 5, 1971, recognized the significance to Brazil of the Rio Symposium and endorsed the active

participation of the joint study group members in all phases of the symposium. Five members of the joint study group are now serving on symposium committees.

1. In view of the recommendation of the Washington workshop, we propose that participation in the symposium be formally recognized as part of the NAS-CNPq activities. The formal participation in the symposium of the joint study group would include several important aspects. To maximize the beneficial impact of foreign participants, the Brazilians should

a. Help coordinate and schedule pre- and post-symposium seminars by the invited speakers. Then nearly every university with a computer facility would benefit.

b. Stimulate personal contacts during the symposium. Typically, many opportunities are lost because of the confusion that surrounds such symposia. The joint study group would act in a systematic fashion to promote effective links between Brazilian and foreign representatives. These links are particularly important to the development of the advanced degree programs of the three major universities.

B. JOINT STUDY GROUP MEETINGS

The final meetings of the joint study group should occur before and after the Rio Symposium. There should be a brief meeting immediately before the symposium and a 2- to 3-day session immediately following it.

1. The first session would serve primarily to assure close coordination of the joint study group activities with the symposium effort and to identify significant questions to be considered at the symposium.

2. The second session should address several subjects, two of which relate closely to the symposium. Again on the theme of optimizing benefits to Brazil, the joint study group should review the information presented at the symposium and extract that which has immediate application to the Brazilian situation. The symposium sponsors may wish to carry out a similar examination for all developing countries. As a result of this analysis, the joint study group may wish to revise or change the emphasis of its final recommendations. The second session should also consider several other objectives, such as the following:

a. The SUCESU should have new manpower statistics from its survey, which should be compared with present estimates. If they differ significantly, a reordering of priorities might be appropriate.

b. The joint study group should also examine the progress in the planning for long-term visits of senior professors and for the Summer Institutes.

c. Since the study group foresees the proposed August meeting as the last planned activity, an evaluation of all its activities to date would be appropriate. Operational difficulties could be examined. Although only a short time has elapsed since the recommendations became available, a first evaluation of their effect should be possible.

The joint study group wishes to acknowledge its preparedness to meet again, if asked, to provide additional support to the planning of computer-science education in Brazil.

AGENDA AND STUDY GROUP MEMBERS

AGENDA

December 10, 1971

A.M. - Review of available data

P.M. - Constructive review of the graduate programs at the Catholic University of Rio de Janeiro and the Federal University of Rio de Janeiro

December 11, 1971

A.M. - A brief visit by two participants to the Federal University of Brasilia

December 13, 1971

A.M. - Visit to the Federal University of Minas Gerais

P.M. - Constructive review of the graduate program at the University of Sao Paulo

Overview of the three graduate programs

December 14, 1971

A.M. - Formulation of recommendations on the strengthening of the three graduate programs

A meeting with CNPq officials

P.M. - Discussion with representatives of the Federal Data Processing Service (SERPRO), computer vendors, and the Association of Users of Electronic Computers and Subsidiary Equipment (SUCESU)

A review of the planning to date for the August, 1972, Rio Symposium on Computer Science Education in Developing Countries

December 15, 1971

A.M. - Visits by small delegations of the joint study group to five computer facilities of users or vendors

P.M. - Summarization and report preparation

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APPENDIX

POSITION PAPER ABOUT THE DEVELOPMENT OF COMPUTER SCIENCE IN BRASIL

Committee of the
Conselho Nacional de Pesquisas do Brasil

Prof. Carlos José Pereira de Lucena, Coordinator
Prof. Celso Renna e Souza
Prof. Denis França Leite
Prof. Oswaldo Fadigas F. Torres

October, 1971.

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5. Appendix II: Outline of the Project of Evaluation and Follow-Up of Data Processing in Brasil.

6. Appendix III: Recommendations made during the second Brazilian Seminar on "Computing at the University"

INTRODUCTION

In August of 1970 a computer-science study group from the National Academy of Sciences and Conselho Nacional de Pesquisas visited several institutions in Brasil and met for discussions at CNPq in Rio. This was part of a continuing study of the area, that was in progress since the end of 1961. As a result of this visit, a draft of a report was written by the American group members and forwarded to their Brazilian counterparts for comments.

What follows is a position paper from a restructured Brazilian study group. The paper is divided into four parts:

I). A general statement of position with respect to Computer Science Education at the University level in Brasil.

II). Comments on the NAS Committee Report.

III). A section containing specific projects based on the past studies and experiences, to be analysed at the next CNPq-NAS meeting.

IV). Miscallaneous appendices quoted in the text.

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PART I

1. COMPUTER SCIENCE EDUCATION AT THE UNIVERSITY LEVEL

The following is a brief analysis of the status and problems of Computer Science education in Brasil, limeted by the scarcity of data and by the distortions imposed by an explosively growing market. The considerations given here are based upon the manpower data displayed in Appednix I.

We shall focus on professionals grouped by the highest degree received and by areas of interest as follows:

A). Ph. D. degree in "Computer Science" (Software, Theory of Computation, Automata and Formal Language, Numerical Analysis, Computer Architecture, etc.).

B). Ph.D. degree in related areas and areas of application. (Control, Operations Research, Management Systems, etc.).

C). M. Sc. degree in Computer Science

D). M. Sc. degree in related areas and areas of application.

E). B. Sc. degree in related areas.

In the above scheme we did not consider the B. Sc. degree in Computer Science since we feel that, from the point of view of national priorities, the education of users of computers at the B. Sc. level has a higher priority.

We can arrive quickly at rough estimates of the demand for professionals of the above levels. Simple-minded as they may be, they will all be on the conservative side and will form a basis for the comments issued throughout the text.

As a starting point, we consider the existence today in Brazil, of 630 installed computers (SUCESU). The distribution of these machines is:

Universities and Research Centres	40
Industry and Commercial Firms	590

Let us assume that the present growth rates in the installation of new computers will be maintained (see Appendix I). In this case it will be of about 30% per annum. Let us also conservatively assume that in the near future the number of men grouped around each of the machices will be approximately the same.

Let us firstly consider the Universities and Research Centres. The former are concerned with extensive teaching of Computer Science, the spreading of the use of computers by all of their Departments, and with research done by their faculty members. The latter are concerned with utilization of computers in specific research activities and with research in Computer Science proper. We shall <u>underestimate</u> the needs of such centres as follows:

Classe A	1
Classe B	2
Classe C	4
Classe D	8
TOTAL	15

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Considering now the computer centres in the Industry and Commerce, we shall make an estimate of the number of analysts, and operators (appendix ():

Analysts	2440
Programmers	2680
Operators	2584

Assuming that about 60% of the analysts are of level E, we sall have about 1460 professionals at this level. We shall assume also that about 20% of the analysts are of levels C and D (say 5% from C and 15% from D).

With these very conservative assumptions we arrive to the following figures:

Demand for specialists in computing

	Present	Annual growth
Level A	40	12
Level B	80	24
Level C	233	70
Level D	539	162
Level E	1168	350

The problem that the Brazilian university has to cope with is therefore to fill the present demand as rapidly as possible and to try to keep up with the growth rate.

Several strategies offer themselves as possible solutions, namely:

a. developing centres of excellence in the country;
b. sending people to specialize abroad (in general);
c. importing foreign specialists (in general).

Strategy a seems to be the least expensive and it is clearly the best in long range terms, although b and c should simultaneously be used on a minor scale.

This being an initial plan, emphasis is given to strategy a. Accordingly three projects are presented here aiming at the consolidation and reinforcement of the major centres that presently exist in Brazil. Meanwhile Brazilian agencies are providing for b an c.

At the next stages other projects will be oriented to increase even more the effort in strategy a.

There are, in Brazil, one already well established program in C.S., one in its first year and one in the advanced planning stage. If the present situation does not change considerably, they may be able to form only about one fourth of the above numbered specialists in levels C and D, wich same added effort to form, within three years, about 10 specialists in levels A and B.

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2. GENERAL REMARKS

Consideration is given to specific needs of each institution in the individual projects presented in Part IV.

In this section it is indicated how, after reinforcing each institution, an integrated action can be achieved.

1. At regular intervals the three institutions would schedule seminars as an opportunity to discuss common problems, and given their small number, to avoid duplication of efforts.

2. By pooling their specialists, they would promote short up-dating courses for professionals already working in computing in universities and in industry.

3. They would agree as to which smaller universities in the country should be in each one's charge, with a view to help such universities, maintaining exchange programs with them, and eventually helping them to raise to the status of new centres of excellence.

PART II

COMMENTS ON THE NAS COMMITTEE REPORT

The NAS Committee Report contributed to the existing Brazilian policy with respect to the problems in the area of computing. A simple analysis of the present document and its comparison with de mentioned report exhibits its extensive utilization. In what follows some concise comments are made on most of the ideas raised by the NAS report.

2.1 - MANPOWER SURVEY

The idea of the manpower survey raised during the last NAS - CNPq meeting in Ric was taken into account throughout this text. Appendix I contains partial results that were used for the preliminary evaluations made in Part I and Appendix II contains an outline of a project that is being carried out by the Brazilian Computer Users Association (SUCESU) and that on the oppinion of the CNPq Committee deserves the support of CNPq.

2.2 - FOREIGN VISITORS

Part I is very explicit with this respect, though it might be called to the attention of the NAS Committee that the import of foreign specialists to work for industry has some drawbacks. The effects on their performance due to cultural and language differences must be carefully avoided.

2.3 - CENTRES OF EXCELLENCE

The Brazilian Committee fully agrees with this idea. It must be pointed out that this is a strategy that has been traditionally carried out by the National Research Council of Brasil.

2.4 - LONG RANGE PLANS

The Brazilian Committee does not believe in predictions made by models which are considerably more sophisticated than the one proposed earlier in the present report. The use of short range plans in conjunction with tight control mechanisms seems a more approppriate strategy to be used in such an explosively growing field as computing in Brasil.

2.5 - FINANCING OF COMPUTING CENTRES

This same recommendation was issued earlier this year in the proceedings called "Seminar Computing at the University" where 26 universities in the country expressed their concern about the problem. In the following seminars to be organized by the Conselho Nacional de Reitores (Twice a year) the CNPq will make sure that this problem is reviewed. Note that the mentioned recommendation was made directly to all university presidents in the country. In Appendix III we can find the main recommendations issued during the mentioned seminar.

2.6 - TRAINING AND RETRAINING

The item called "General Remarks" in Part I reflects the use that was made of the NAS Committee recommendation.

2.7 - SMALL SCHOOLS WITHOUT COMPUTERS

Same as 2.6.

2.8 and 2.9 - COMPUTER SCIENCE CURRICULA

An analysis of the three projects presented with this report exhibit the following aspects:

a. Diversification of areas of interest of the Centres of Excellence

b. Concern with the application aspects of computing.

Furthermore it must be noted from Part I. the importance given to applications by the Brazilian study group.

2.10 through 2.17

The recommendations about Education Abroad agree with what is indicated in Part I of the present report.

The only remark is that the emphasis on education abroad should not jeopardize the development of the national centres of excellence.

As to the other recommendations there are no objections. They should be gradually and simultaneously implemented.

The November NAS - CNPq meeting can act as an opportunity for the selection of some of them for immediate implementation.

2.18 - CONTINUATION OF THE CNPq - NAS COMPUTER SCIENCE PANEL

The NAS report and to a minor extent the present one reflect a degree of generality that is due to the lack of more data and of detailed planning for some specific aspects. We are very sure that the continuation of the CNPq - NAS

./.

Computer Science Panel will result in very profitable results to Computer Science development in Brasil. Again, the next November meeting can be used as an opportunity to the definition of the dates for the future panel meetings.

P A R T III

In what follows three plans are presented for the development of the existing academic programs of the following institutions:

1. Programa de Ciência de Computação;
   Pontifícia Universidade Católica do Rio de Janeiro

2. Programa de Engenharia de Sistemas;
   COPPE - Universidade Federal do Rio de Janeiro

3. Programa de Computação;
   Universidade de São Paulo

COMPUTER SCIENCE AT PUC/RJ

PROJECT OF DEVELOPMENT

COMPUTER SCIENCE AT PUC/RJ

PROGRAM OF DEVELOPMENT

1. OBJECTIVES

The main purpose of the Computer Science program at PUC/RJ is to give the student a solid background in the areas of Programming Systems , Theory of Computation, Mathematical Theory of Systems, and Numerical Analysis. This program, in conjunction with the programs of other Departments, provide an effetive training for the application of computers to science and technology in general. This training is offered at the undergraduate and graduate levels.

2. THE GRADUATE PROGRAM

Since 1967 the Departamento de Informática of PUC/RJ, initially through the Departamento de Matemática, offers an active graduate program in Computer Science. This program requires from the student from one and a half to two years of study, for the M. Sc. degree.

At the end of the second semester of 1971 there will be about 25 masters graduated from this program. At the present time there are 66 students participating of the program at its different stages.

The graduate students are being absorbed by Brazilian universities and other institutions where the effects of their training are already noticeable (In Annex II are listed a number of such institutions .

Some of them finance their studies even when the students are enrolled in a full-time basis at PUC/RJ).

It is intended to enlarge this program in order to make it capable to absorb a total of 90 students at any given moment, by the beginning of 1972.

The development of the program is indicated in Table I.

When the program attains its steady state, it is estimated to produce 30 M. Sc. per year.

A Ph. D. program in computer science is planned to start as soon as possible in order to supply the faculty that will provide a more solid support for the educational and research programs in Brazil.

Such a program is planned to start in March 1972. At the beginning, the program will have three students and will grow up to 15 by ... 1977. The first students to graduate through this program will come out around 1974.

It is estimated that the program will be producing 15 Ph.Ds. per year by 1978. (Table I).

The starting point being March 1972 is connected to the availability of a few professors due to enroll in the Department from January to March 1972.

3. THE UNDERGRADUATE PROGRAM

The PUC/RJ has already trained a large number of students in the foundations of Computer Science, Numerical Calculus, and Computer Applications.

The students come from the areas of Engineering, Basic Sciences, Social Sciences, and Humanities.

In particular students in Electrical Engineering may study Computer Science as an option in their program. Also in Mathematics a minor is provided for those interested in computing (Annex I).

A program that attained its steady state by 1968 is responsible for the training of 1200 students per year in the functions of Computer Science and for the formation of about 50 specialists in computing, (minors in Mathematics and Electrical Engineering) per year, This last figure is expected to grow to about 70 in 1972.

4. RESEARCH

Besides several research projects carried on by each member of the faculty, there are some major projects, involving groups of people from the faculty, graduate student body, and from the Computing Centre.

Among them one could mention the utilization of mini- computers for educational purposes and related efforts such as software development, computers in hospitals, ALGOL 68 implementation problems, extention of high-level languages, large scale information retrieval and date bases , etc.

Samples of past research projects are listed in Annex III.

5. REQUIREMENTS FOR THE DEVELOPMENT

With the purpose of establishing a rather complete program of studies at graduate and undergraduate level, as well as high level research projects, a number of requirements should be fulfilled.

These requirements may be grouped as follows:

a. expansion of faculty;
b. expansion of course offerings;
c. expansion of faculty exchange program;
d. expansion of library facilities.

5.1 - FACULTY AND NEW COURSES

The number of professors in the Departamento de Informática must be increased in order to cope with the planned growth of the number of students in particular at graduate level.

The present faculty is composed of 23 full time members (five in leave of absence), six of which have Ph.D. degrees the others having M. Sc. degrees.

These figures are to be changed to 15 and 15 by 1975.

The planned growth for the Department in the period of 1971 - 1978 is illustrated in Table I.

The staff of the Computing Centre of PUC/RJ (Rio Datacentro) has more than 20 high-level specialists (more than 50% having post- graduate degrees).

These specialists are to be considered as support for the research activities of the Departamento de Informática.

The number of professors at Ph.D. level is to be enlarged through one of the two following strategies:

a. hiring of computer scientists who already have the Ph.D. degree and a working experience in research;

b. sending members of the faculty abroad for attending Ph. D. programs.

As to b it must be noted that the five faculty members on leave of absence are enrolled in such Ph. D. programs; also agreements are being established for faculty members to spend part of the program time at PUC, when they would be at the same time working at their academic activities .

It exists already at PUC/RJ an adequate number of available courses for students working at the M. Sc. level, students specializing in computing at the B. Sc. level, and introductory courses of general use for all the Departments.

Such courses are described in Annex I.

Nevertheless, with the purpose of offering a complete Computer science program from the undergraduate to the Ph. D. level, a number of new courses and seminars are to be included in the existing program.

It is worthwhile mentioning at this point that PUC/RJ is in the process of reaching the present stage of technology both from the hardware and software points of view. This implies that new areas of study are being opened, as for instance computer aided instruction and design, computer graphies, time-sharing computer systems, etc.

5.2 - FACULTY EXCHANGE PROGRAM

The exchange program is vital to keeping the research efforts directed to the significant problems and areas.

The research program at PUC/RJ has benefited from this along its existence.

The main strategies to accomplish an exchange program are:

a. to exchange faculty members for specific research works , so that our specilists will have the chance to work with the top specialists in their fields, summer periods seem appro - priate for this respect;

b. to have in a long term basis foreing visiting professors;

c. to send faculty members to international conferences and seminars, both to present papers and to interact with the world community in computing.

5.3 - LIBRARY FACILITIES

To cope with the development of the courses and research projects a fairly large library facility should be available.

It should subscribe all the major journals, conference proceedings, bulletins, etc., that report the state of the art and progess in Computer Science

TABLE I

		MARCH 1971	MARCH 1972	MARCH 1973	MARCH 1974	MARCH 1975	MARCH 1976	MARCH 1977
STUDENTS	Undergraduate students taking basic computing courses.	1200	1200	1200	1200	1200	1200	1200
	Graduate students in the Computer Science option (this does not include those who apply computers in their specialties)	50	70	70	70	70	70	70
	Graduate students at all levels of the M. Sc. program (failure rate of about 20%)	66	90	90	90	90	90	90
	Graduate students at all levels of the Ph. D. program (failure rate of about 30%)	-	3	8	12	15	15	15
	Special students in extension courses programs	400	500	700	1000	1000	1000	1000
FACULTY	Ph. D. level (permanent)	6	8	10	12	15	16	17
	M. Sc. level (permanent)	17 (5 absent)	17 (4 absent)	15 (2absent)	15	15	15	15
	Visiting (1 year average stay)	5	5	5	5	5	5	5

T A B L E - 1 (cont.)

		MARCH 1971	MARCH 1972	MARCH 1973	MARCH 1974	MARCH 1975	MARCH 1976	MARCH 1977	MARCH 1978
* COURSES	Number of undergraduate courses	6	7	10	10	10	10	10	
	Number of graduate courses	20	22	24	25	30	30	30	
	Number of extension courses	10	15	15	15	15	15	15	
** GRADUATES	B. Sc. computing option graduates engineering and mathematics	50	120	190	260	330	400	470	
	M. Sc. graduates	16	30	50	75	105	135	165	
	Ph. D. graduates	-	-	-	2	7	17	29	44

* COURSES: The data refer to the number of courses rather than to the number of times each one is offered.

** GRADUATES: The data refer to the number of students graduated up to the corresponding year.

ANNEX I

DEPARTAMENTO DE INFORMÁTICA

CORPO DOCENTE

Coordenador do Programa:

CARLOS JOSÉ PEREIRA DE LUCENA

Professôres:

Alexandre Bestougeff, D.Sc., 1970, Universidade de Paris.

Antonio Cesar Olinto, Ph.D., 1966, Massachussetts Institute of Technology.

Antonio Luz Furtado, M.Sc., 1968, PUC/RJ.

Arndt Von Staa, M.Sc., 1968 - PUC/RJ. ***

Carlos José Pereira de Lucena M.Math,. 1969 - University of Waterloo.

Donald D. Cowan, Ph.D. University of Waterloo.*

Donaldo de Souza Dias, M.Sc., 1970 - PUC/RJ.**

Firmo Freire, M.Sc., 1969 - PUC/RJ.***

Graciano Sá, Ph.D., 1968, Massachussetts Institute of Technology.

Heitor M. Quintella, M.Sc., 1971 - PUC/RJ.

Larry Kerschberg, Ph.D. 1969 - Case Western Reserve University.

Luiz de Castro Martins, M.Sc., 1970 - PUC/RJ (RDC).

Luiz Edmundo R. Soares, M.Sc., 1969, University of Winsconsin.

Luiz Ferrara A. Cunha, M.Sc., 1971 - PUC/RJ.

Klaus Galda, Ph.D. (em conclusão), 1971 - Stanford University.

Mário Telles Ribeiro, M.Math, 1968 - University of Waterloo.**

Marilia Rosa Millan, M.Sc., 1971 - PUC/RJ.

Nelson do Valle Silva, M.Sc., 1971 - PUC/RJ.

Peter Albrecht, Ph.D., 1967 - Univ. Munique

Renato Perrone, Doutor em Ciências, 1950 - UFRGS.

Roberto Lins de Carvalho, M.Sc., 1969 - PUC/RJ.

Sérgio Eduardo Rodrigues Carvalho, M.Sc., 1969 - PUC/RJ.***

Sérgio R.P. Teixeira, Ph.D., 1970, University of Califórnia (Bekerley).

Sueli M. dos Santos, Ph.D. (conclusão), 1971 - Stanford University.

Simão Sirineo Toscani, M.Sc., 1969 - PUC/RJ.

Vitor Moreno, M.Sc., 1970, University of Illinois.

Vitoriano Ruas Santos, M.Sc., 1971 - PUC/RJ.

* - Visitante por curtos períodos; consultor de programa.

** - Tempo parcial.

*** - Ausente em programa de doutoramento.

O programa de estudos em nível de pós-graduação em Informática iniciou-se no ano de 1967. Nêsse ano as disciplinas na área de computação eram coordenadas pelo setor de Matemática Computacional do Departamento de Matemática. A ampliação dêste setor nas áreas de graduação e pós-graduação originou a criação do Departamento de Informática, em 1968, estruturado com íntima ligação com o Rio Datacentro.

O Rio Datacentro, criado em 1966, dêsde esta época centraliza todos os recursos de computação digital da Universidade.

O Departamento tem à sua disposição o equipamento do Rio Datacentro que conta com os computadores: IBM 7044/1401 e o computador IBM 1130.

CURSO DE GRADUAÇÃO:

O Departamento de Informática mantém duas categorias de curso em nível de graduação: cursos básicos e cursos de especialização. Os cursos básicos são lecionados nos 1os ciclos dos três Centros da Universidade (Técnico Científico, Ciências Sociais, Teologia e Ciências Humanas). O programa mais expressivo é o lecionado no CTC no qual figuram as cadeiras de Introdução à Ciência de Computadores (INF-1001) e Cálculo Numérico (INF-1002) em caráter obrigatório. São ministradas aulas para quatro turmas nêste nível, duas de ICC e duas de Cálculo Numérico e cada cadeira se subdivide em 8 turmas para as aulas de problemas ministradas por monitores.

O Departamento mantém uma seção de atendimento onde 12 monitores se revezam ao longo do dia tirando dúvidas a respeito da programação e solução numérica de problemas. A cadeira INF 1001 é, também, oferecida ao CCS e CTCH com algumas adaptações no currículo. Nêstes Centros esta cadeira é eletiva.

Cinco disciplinas são lecionadas para alunos de últimos anos do CTC, são elas Sistemas de Computação INF-1003, Introdução às Estruturas de Informação INF-1004, e Elementos de Teoria de Computação INF-1005, Linguagens de Programação INF-1006 e Organização de Computadores INF-1007. Embora as cadeiras de destinem a dar uma formação mais especializada a alunos de qualquer Departamento do CTC elas foram organizadas tendo em mente primariamente alunos da última série do curso de Matemática e alunos dos últimos períodos de crédito de Engenharia Elétrica na opção Engenharia de Sistema.

Vale mencionar que as cadeiras de Aplicações de Computadores dentro de áreas específicas estão a cargo dos respectivos Departamentos.

CURRÍCULO:

INF-1001 - Introdução à Ciência de Computadores	3-1-0	4		
INF-1002 - Cálculo Numérico	3-1-0	4	MAT	1101
			INF	1001
INF-1003 - Sistemas de Computação	3-0-0	3	INF	1007
INF-1004 - Introdução às Estruturas de Informação	3-0-0	3	INF	1002
INF-1005 - Elementos de Teoria da Computação	3-0-0	3	INF	1004
INF-1006 - Linguagens de Programação	2-1-0	3	INF	1002
INF-1007 - Organização de Computadores	2-1-01	3	INF	1006

DISCIPLINAS OFERECIDAS EM NÍVEL DE GRADUAÇÃO

Observação: As disciplinas dêste Departamento são identificadas pela sigla INF seguida de um número que:

a) - O algarismo do milhar indica o nível em que é ministrada a disciplina, a saber:

1 - nível de graduação
2 - nível de pós-graduação

b) - Os demais algarismos enumeram as disciplinas.

INF - 1001 - INTRODUÇÃO À CIÊNCIA DE COMPUTADORES:

Conceitos básicos Programação no Computador Hipotético PUC 007. Algoritmos e Fluxogramas. Estudo completo da Linguagem FORTRAN IV (Stafor). Aplicações Numéricas básicas: raízes de equações; integração; Sistemas de equações lineares. Aplicações não numéricas: manipulação de caracteres; variáveis lógicas. (3-1-0) 4 créditos.

INF - 1002 - CÁLCULO NUMÉRICO

Erros; geração e propagação. Solução de equações não lineares. Interpolação e aproximação. Diferenciação e Integração. Matrizes e Sistemas de equações lineares. Solução de equações diferenciais. (3-1-0) 4 créditos MAT-1101

INF - 1006 - LINGUAGENS DE PROGRAMAÇÃO:

Linguagens de alto nível: ALGOL, PL/I, APL, SNOBOL. Prática de programação de problemas numéricos. Prática de programação de problemas não numéricos. (2-1-0) 3 créditos. INF-1002.

INF - 1007 - ORGANIZAÇÃO DE COMPUTADORES:

Representação de informação. Sistemas de numeração. Organização básica: memória; unidade de contrôle; unidade aritmética; unidades de entrada e saída. Descrição de sistemas existentes. (2-1-0) 3 créditos. INF - 1006.

OBJETIVOS DO PROGRAMA

CURSO DE PÓS-GRADUAÇÃO:

O programa de pós-graduação em Informática visa a formar especialistas principalmente nas áreas de Teoria de Computação, Engenharia de Software, Sistemas de Computação e Análise Numérica. Além dessas áreas, grande ênfase é dada à matemática aplicada e às disciplinas ligadas à Teoria de Sistemas como: a programação matemática e a simulação e teoria matemática de sistemas.

A maioria dos candidatos que têm participado dêste programa se destinam a atividades acadêmicas no grande número de Universidades e centros de pesquisas que já operam centros de computação no Brasil. Entretanto, um número crescente de indústrias que fazem uso de computadores, com a sofisticação dos problemas surgidos em suas organizações, têm demandado pelos especialistas formados pelo nosso programa.

O grau conferido pelo programa é o de Mestre em Ciências (M.Sc.) em Informática.

INSTALAÇÕES

O Departamento de Informática tem à sua disposição o equipamento do Rio Datacentro, o centro de computação da Universidade. Os equipamentos disponíveis são descritos a seguir:

Sistema IBM 360/40

. Unidade Central de Processamento
- Memória: 256 K bytes
- Palavra: 8 bytes
- Tempo de acesso: 2,5 micro-segundos, 2 bytes por acesso.

Canal Multiplexor
- Console 1052-001
- Leitora/Perfuradora 2540-001 - velocidade: leitora: 1000 cartões/min - perfuradora: 300
- Impressora 1403-N01 - velocidade: 1100 linhas/minuto - tamanho da linha: 132 caracteres.

2 Canais Seletores
- 4 unidades leitoras - gravadoras de

Sistema IBM-7044

. Unidade Central de Processamento 7107:
- Memória: 32 K palavras
- Palavra: 36 bits.
- Tempo de acesso: 2s.
- Dispositivos: Relógio interno.
  Proteção de Memória
  Ponto flutuante: precisão simples.
  Ponto flutuante: dupla precisão.

Canal de Dados A

- Sistema auxiliar IBM-1401
- Impressora do operador.

Canal de Dados B

- 8 unidades leitoras-gravadoras de fitas magnéticas 729-IV, 4 destas unidades são intercambiáveis para o sistema auxiliar IBM-1401.

Sistema Auxiliar IBM-1401

Unidade Central de Processamento:
- Memória: 4 K bytes.
- Tempo de acesso: 11,6 s.
- Dispositivo: Programação Avançado.
  Comparação Alta-Baixa-Igual
  Multiplicação-Divisão.
  Coluna Binária.

Impressora IBM-1403

- Velocidade: 600 linhas de impressão/min.
- Tamanho da linha: 132 caracteres.

Leitora/Perfuradora IBM-1402

- Velocidade: Leitora: 80 cartões/min.
  Perfuração: 250 cartões/min.

Mudança de Fitas Magnéticas

- Liga quaisquer de 4 unidades de fita no sistema IBM-7044 ou ao IBM-1401.

Sistema IBM-1130

Unidade Central de Processamento IBM-1131 - mod. 28.
- Memória: 8 K. palavras.
- Tempo de acesso: 3,6 s
- Dispositivos: Impressora-teclado.

Impressora IBM-1132

- Velocidade: 80 linhas de impressão/min.
- Tamanho da linha: 120 caracteres.

Leitora-Perfuradora de Cartões IBM-1442 mod 7

- Velocidade: Leitura: 400 cartões/min
  Perfuração: 160 colunas/min.

Traçador de Gráficos IBM-1627 mod. 2

- Área para traçar: 29 1/2 "X 120
Equipamento Convencional.

Máquina de Contabilidade IBM-407

- Velocidade: 150 linhas de impressão/min.
- Tamanho da linha: 120 caracteres.

Reprodutora-Perfuradora de Cartões IBM-314

- Esta máquina possui dispositivo de "mark sensing".

Classificadora de Cartões IBM-083

- Velocidade: 1.000 cartões/min.

Classificadora de Cartões IBM-082

- Velocidade: 650 cartões/min.

Perfuradora de Cartões IBM-029

- 21 máquinas dêste tipo.

Verificadora de Cartões IBM-059

ÁREAS DE CONCENTRAÇÃO

O programa de mestrado em Informática compreende quatro áreas de concentração, a saber:

1. Análise Numérica
2. Sistemas de Programações
3. Teoria de Computações
4. Teoria Matemática de Sistemas

As disciplinas que constam em cada uma destas áreas se combinam e se completam para a formação do programa acadêmico específico de um aluno.

REQUISITOS ESPECIAIS EXIGIDOS PELO DEPARTAMENTO

Além dos requisitos constantes nas NORMAS REGIMENTAIS DOS CURSOS DE PÓS-GRADUAÇÃO Item 5 da Seção II, o Departamento de Informática exige do candidato:

1. Quanto à admissão e matrícula:

   a) Ser graduado em qualquer outro curso superior que tenha proporcionado ao candidato experiência e conhecimento suficientes para acompanhar os cursos e participar dos trabalhos

b) Ter o seguinte nível mínimo em Matemática: dois períodos letivos (um ano) em Cálculo, um período letivo em Cálculo Numérico, um período letivo em Probalidade e Estatística, um período letivo em Programação de Computadores Digitais.

Observação: A aceitação do candidato será feita com base no "curriculum vitae", e, se necessário, numa entrevista com professor autorizado. A Coordenação do Mestrado, fica reservado o direito de recusar candidatos que tenham cumprido deficientemente êstes requisitos e o de aceitar candidatos com boa formação que venham a cumprir os mesmos ao longo do programa.

II. Quanto à Qualificação ao Título de Mestre:

A coordenação do Mestrado em Informática estruturou duas formas de preencher os requisitos para a conclusão do curso de Mestrado, objetivando dar diferentes tratamentos ao aluno que se dirige a um posterior doutoramento (Plano A) e ao aluno que curse o Mestrado sem intenções de fazer o Doutorado (Plano B).

Embora seja esta a razão pela qual existem os dois planos, o aluno poderá optar por um dêles, segundo critério pessoal e sob a orientação do seu professor orientador, até o final do segundo período letivo

Seguem-se os requisitos especiais exigidos pelo Departamento para cada um dos planos.

Plano A

a) Obter um total de 24 créditos em 8 disciplinas de pós-graduação que podem ser substituídas, em casos especiais, por seminários e trabalhos individuais, a critério do Professor orientador.

b) Ser aprovado na matéria coberta pela área de concentração selecionada, através de um exame de qualificação;*

c) Defender uma tese cuja carga de trabalho foi dimensionada para elaboração dentro de um prazo aproximado de 2 meses;

d) Ser aprovado em exame de língua inglêsa.

Plano B

a) Obter um total de 24 créditos em 8 disciplinas de pós-graduação que podem ser substituídas, em casos especiais, por seminários e trabalhos individuais, a critério do Professor orientador;

b) Defender uma tese cuja carga de trabalho foi dimensionada para elaboração dentro de um prazo aproximado de seis meses;

c) Ser aprovado em exame de língua inglêsa.

* As questões formuladas neste exame, embora rigorosamente dentro do programa dos cursos, serão retiradas de exames de qualificação para programas de Doutoramento em Universidades internacionalmente conceituadas.

CURRÍCULO

O currículo compreende disciplinas obrigatórias e disciplinas eletivas, autorizando-se a inscrição do aluno em disciplinas que forneçam até um máximo de 12 créditos por semestre.

As disciplinas obrigatórias são, além da Tese de Mestrado, as da área de concentração selecionada.

Entre as eletivas, o aluno poderá escolher tanto disciplinas oferecidas por outros Departamentos como as das outras áreas de concentração não escolhidas e as eletivas oferecidas pelo Departamento de Informática, a saber: Análise de Sistemas e Processamento de Dados e seminários e/ou trabalhos individuais.

Os seminários, que têm a duração de 2 meses, objetivam o aprofundamento dos tópicos tratados dentro das disciplinas oferecidas ou abordam assuntos não cobertos pelo programa, envolvendo aulas, trabalhos, provas, etc. Sua programação é extremamente flexível, já que depende principalmente de professôres visitantes e do interêsse dos alunos. Para efeito de créditos, dois seminários valem três créditos.

DISCIPLINAS OBRIGATÓRIAS

CÓDIGO	NOME DA DISCIPLINA	CRÉDITO	PRÉ-REQUISITO
INF 2000	Tese de Mestrado	0	-
	1. Área de Análise Numérica		
INF 2001	Introdução à Análise Linear	3	-
INF 2002	Análise Numérica I	3	INF 2001
INF 2003	Análise Numérica II	3	INF 2001
INF 2004	Tópicos em Análise Numérica	3	-
	2. Área de Sistemas de Programação		
INF 2101	Linguagens de Programação	3	-
INF 2102	Estruturas de Informação	3	-
INF 2103	Construção de Compiladores	3	INF 2101
INF 2104	Sistemas de Computação I	3	-
INF 2105	Sistemas de Computação II	3	INF 2104
	3. Área de Teoria de Computação		
INF 2201	Teoria de Computação I	3	-
INF 2202	Teoria de Computação II	3	-
INF 2203	Linguagens Formais e Autômata	3	INF 2201
INF 2204	Álgebra Moderna Aplicada	3	-

INF 2205	Teoria dos Grafos Aplicada	3	-
	4. Área de Teoria Matemática de Sistemas		
INF 2301	Programação de Matemática I	3	-
INF 2302	Programação Matemática II	3	-
INF 2303	Simulação Discreta	3	-
INF 2304	Teoria de Sistemas	3	INF 2204

DISCIPLINAS ELETIVAS

INF 2401	Análise de Sistemas de Processamento de Dados	3
INF 2402	Tópicos em Ciências de Computação	3
INF 2403	Seminários e Trabalhos Individuais (trabalho correspondente a 2 seminários ou 2 trabalhos individuais ou a um seminário e um trabalho individual)	3

e mais disciplinas das áreas de concentração que não a escolhida e disciplinas de outros Departamentos.

CURSOS DE SERVIÇO

O Departamento de Informática oferece ainda a outros departamentos da PUC/RJ as seguintes disciplinas:

INF	2501	Programação de Computadores para Ciências e Engenharia	3	-
INF	2502	Programação de Computadores para as Ciências Humanas e e Sociais.	3	-

DEPARTAMENTO DE INFORMÁTICA

As disciplinas deste Departamento são identificadas pela sigla INF seguida de um número em que:

a. O algarismo do milhar 121 indica que a disciplina é ministrada em nível de pós-graduação (o algarismo 1 caracteriza a disciplina em nível de graduação).

b. Os demais algarismos enumeram as disciplinas.

EMENTAS DAS DISCIPLINAS

INF 2000 - Tese de Mestrado - Sem direito a crédito.

INF-2001 - INTRODUÇÃO À ANÁLISE LINEAR

Espaços vetoriais reais. Transformações lineares e matrizes. Teoria geral das equações diferenciais lineares. Equações com coeficientes constantes. Espaços Euclidianos. Convergência em espaços euclidianos. Séries de Fourier. Séries ortogonais de polinômios. Problemas de contôrno em equações diferenciais ordinárias e parciais. (3-0-0) 3 créditos.

Bibliografia: Kreider - An Introduction to Linear Analysis.

INF-2002 - ANÁLISE NUMÉRICA I

Elementos da Análise Funcional: Espaço de Banch; operadores; teorema do ponto fixo. Métodos iterativo para equações e sistemas transcendentes. Zeros de polinômios: métodos de Newton, Bairstow; algorítmo QD. Métodos diretos para sistemas lineares e inversão de matrizes: algorítmo de Gauss, métodos compactos de Crout Banachievicz e Cholesky, método escada e partição geral. Teoria das matrizes: autovetores, normas matriciais, raio espectral, limitações dos autovalores, forma canônica de Jordan, grafos finitos, elementos da teoria de Frobenius, matrizes fracamente cíclicas e consistentemente ordenadas. Métodos iterativos para sistemas: iterações simples e bloco de Jacobi, Gauss-Seidel e sôbre-relaxação, convergência, teoremas de comparação de Stein-Rosenberg e Ostrovski, teoria de Young e generalizações da sôbre relaxação. (3-0-0) 3cr - INF 2002

Bibliografia: Collatz - Functional Analysis and Numerical Mathematics.
Henrici - Elements of Numerical Analysis.
Varga - Matrix Iterative Analysis.

INF-2003 - ANÁLISE NUMÉRICA II

Interpolação: diferenças, interpolação de Lagrange e Newton, algorítmos de Aitken e Neville, aplicações à diferenciação numérica e aos métodos iterativos: Quadratura; fórmulas de Newton-Cotes métodos de Romberg, métodos de Gauss; considerações de êrro e convergência, discussão geral da extrapolação de Richardson. Equações diferenciais; métodos de Runge-Kutta métodos "multistep" de Adams-Bashforth e Nystrom, métodos preditor - corretor de Adams - Moulton e Milne - Simpson, consistência e estabilidade, convergência, métodos de extrapolação, comparação de métodos. (3-0-0) 3cr - INF 2001.

Bibliografia: Ralston: A First Course in Numerical Analysis.
Henrici: Discrite Variable in Ordinary Differential Equations.

INF-2004 - TÓPICOS EM ANÁLISE NUMÉRICA

Resolução de equações diferenciais parciais elípticas, parabólicas e hiperbólicas pelo método de diferenças finitas. Processos iterativos sôbre relaxação. Método semi-iterativo de Chabyshev. Direções alternadas. Métodos variacionais e equações integrais. Métodos de Monte Carlo. (3-0-0) 3 cr. - INF-2003.

Bibliografia:

"papers" selecionados.

INF-2001 - LINGUAGENS DE PROGRAMAÇÃO

Algorítmos, Algorítmos de Markov. Estrutura e linguagem de máquina, Processos de Interpretação e Compilação, Família de algorítmos para a construção de interpretadores e compiladores. Estrutura da linguagem ALGOL. Estrutura da linguagem PL/I. Extensão de Linguagens de Programação. Macro-geradores, compiladores de compiladores. Projeto de linguagens de programação com compiladores de compiladores (3 créditos) (3-0-0).

Bibliografia: Wegner - Programming Languages, Information Structures, and Machine Organization.
Galler e Perlis - A view of Programming Languages.

INF-2102 - ESTRUTURAS DE INFORMAÇÃO

"Arrays". Cadeias de caracteres e de bits. Filas. Pilhas e recursividade. Listas. Plexos. Árvores, Tabelas de Símbolos. Estruturas blocadas. Alocação dinâmica de memória. Linguagens e extensões de linguagens para estruturas de informação. Formalização de conceitos em estruturas de informação. (3-0-0) 3 cr.

Bibliografia: Knuth - The Art of Computer Programming - vol. 1
Rosen - Systems and Programming Languages.

INF-2103 - CONSTRUÇÃO DE COMPILADORES

Construção de compiladores com sintaxe implícita. Algorítmos para interpretação e compilação, organização geral de um compilador, compiladores "load and go". Compiladores dirigidos por sintaxe. Análise sintática, Precedência matrizes de transição,

Linguagem de produção. Compiladores de compiladores. (3-0-0) 3 créditos. INF 2101

Bibliografia: "papers selecionado".

INF-2104 - SISTEMAS DE COMPUTAÇÃO I

Organização lógica de computadores digitais; álgebra de Boole noções; unidades funcionais; organização de máquinas; ciclo de operação macro-instruções. Programas carregadores. Sistemas de entrada e saida. (Hardware e Software). (3-0-0) 3 cr.

Bibliografia: "papers" selecionado.

INF-2105 - SISTEMAS DE COMPUTAÇÃO II

Supervisores de interrupção. Supervisores de operação. Sistemas de multiptogramação. Computadores virtuais. "Time Sharing" (3-0-0) 3 cr. - INF 2104.

Bibliografia: "papers" selecionados.

INF-2201 - TEORIA DE COMPUTAÇÃO I

Conjuntos, relações e funções, conceitos de álgebra. Cálculo proposicional. Cálculo funcional de primeira ordem. Funções recursivas. Teorema de Gödel. Computabilidade de funções e predicados. Tese de Church (3-0-0) 3 cr.

Bibliografia: Mendelson - Introduction to Mathematical Logic.

INF-2202 - TEORIA DE COMPUTAÇÃO II

Recursividade de conjuntos. Resultados dos básicos de insolvabilidade. Conjuntos criativos e produtivos. Computabilidade relativa. Teorema de recursão. Redutibilidade de Turing. Hierarqui aritmética. (3-0-0) 3 cr.

Bibliografia: Rogers - Recursive Functions and effective computability.

INF-2203 - LINGUAGENS FORMAIS E AUTÔMATA

Linguagens formais, introdução, definições e exemplos. Classificação das linguagens regulares e o autômato finito. Linguagens livres do contexto e o "push-down automata". Máquinas de Turing. Linguagens determinísticas. Operações sôbre linguagens. (3-0-0) 3 cr. - INF 2201.

Bibliografia: Hopcroft e Ullman - Formal Languages and their relation to Automata.

INF-2204 - ÁLGEBRA MODERNA APLICADA

Conjuntos, funções, relações, equivalências, conjuntos quocientes. Operações binárias, semigrupos, monoides, grupos, decomposição de semigrupos. Grupos simétricos e cíclicos, grupo de transformações, classes laterais, grupos normais, anéis e módulos, forma canônica racional. (3-0-0) 3 cr.

Bibliografia: Mac Lane e Birkhoff - Álgebra
Birkhoff e Bartee - Modern Applied Algebra

INF-2205 - TEORIA DOS GRAFOS APLICADA

Introdução e definições, Matrizes e operações em grafos. Árvores. Conectividade, Partições, Jogos, Caminhamento, Fatores e coberturas. Planaridade e número cromático. Dígrafos, rêdes, torneios. Grupos em grafos, Isomorfismo de grafos. (3-0-0) 3 cr. - INF 2204

Bibliografia: Harary - Graph theory,
Berge - Théorie des Graphes et ses Applications..

INF-2301 - PROGRAMAÇÃO MATEMÁTICA I

Programação linear, Método Simplex, Dualidade. Análise de Sensibilidade. Rêdes e transporter. Introdução a tópicos avançadas como programação inteira e decomposição. (3-0-0) - 3 cr.

Bibliografia: Dantzig - Linear Programming and Extensions.
Ford - Fulkerson - Flows in Networks.
Hu - Integer Programming and Network Flows.
Wagner - Principales of Operations Research.

INF-2302 - PROGRAMAÇÃO MATEMÁTICA II

Programação não-linear inteira e dinâmicas. Teoria de conjuntos convexos, métodos de Gradiente, Kuhn-Tucker, programação quadrática, problemas não-lineares por decomposição. Recursões; caminhos mais curto e "knapsack". Programação inteira, Gomory, "Branch and Bound" , algorítmos e assintáticos. (3-0-0) 3 cr.

Bibliografia: Hadley - Non Linear and Dynamic Programming.
Bellman - Dreyfus - Dynamic Programming.
Mangasarian - Non Linear Programming.
Hu - Integer Programming and Network Flow.

INF-2303 - SIMULAÇÃO DISCRETA

Introdução: conceito, classificação e propósitos da simulação. Como conduzir um estudo de simulação. Geração de números aleatórios, base matemática: métodos de geração para computadores, testes de verificação de aleatoriedade. Geração de variáveis estocásticas para simulação: algorítmos para distrubuições contínuas; algorítmos para distribuições discretas. Modêlos computacionais de filas, estoques e sistemas de programação industrial. Simulação de sistemas econômicos. Linguagens de simulação: GPSS III ; Simscript; Dynamo. O problema da validade do modêlo. (3-0-0) 3 cr.

Bibliografia: Naylor - Computer Simulation techniques.

INF-2304 - TEORIA DE SISTEMAS

Tempo. Classificação de Sistemas de Sinais Entrada-Saída. Evolução e Estabilidade. Interconexão de sistemas. Sistemas causais e não-antecipatórios o conceito de estado, a relação de Nerode. Sistemas transicionais e módulo, forma canônica racional. Sistemas' Multilineares, produto tensorial, interconexão, decomposição, realização. (3-0-0) - 3cr. INF 2001.

Bibliografia: notas mimeografadas.

INF-2401 - ANÁLISE DE SISTEMAS DE PROCESSAMENTO DE DADOS

Programação com fitas e discos. Estruturação e processamento de arquivos. Classificação e pesquisa. Levantamento. Projeto de documentos de entrada. Fluxo e contrôle de informações, planejamento de sistemas. Estudo de viabilidade e instalação. (3-0-0) 3 cr.

INF-2402 - TÓPICOS EM CIÊNCIAS DE COMPUTAÇÃO

"Pattern Matching". Manipulação de fórmulas. Inteligência Artificial. Demonstração de teoremas. Recuperação de informações. (3-0-0) 3 cr.

Bibliografia: "papers" selecionados.

INF-2403 - SEMINÁRIOS E TRABALHOS INDIVIDUAIS

Trabalho correspondente a dois seminários, ou dois trabalhos individuais ou um seminário e um trabalho individual.

INF-2501 - PROGRAMAÇÃO DE COMPUTADORES PARA CIÊNCIAS E ENGENHARIA

Conceitos básicos de computadores. Linguagens de máquina e linguagem FORTRAN IV. Métodos numéricos para cálculo de raízes de equações, interpolação, integração, solução de sistemas de equações lineares, cálculo de auto-valores e auto-vetores e solução de equações diferenciais ordinárias. Manipulação de caracteres. Introdução às estruturas de informação: filas, pilhas, listas, árvores e tabela de símbolos. Introdução aos sistemas operacionais: canais, "buffers", entrada e saída e processamento simultâneos, multiprogramação e time - sharing. (3-0-0) 3 cr.

Bibliografia: Southworth - Digital Computation and Numerical Methods.

Lucena - Introdução às Estruturas de Informações.

INF-2502 - PROGRAMAÇÃO DE COMPUTADORES PARA AS CIÊNCIAS HUMANAS E SOCIAIS

Conceitos básicos de computadores. FORTRAN IV. Aplicações matemáticas elementares. Aplicações estastísticas usuais: subrotinas utilitários e programas especiais. Álgebra Matricial e aplicações. SNOBOL. Processamento não numérico. (3-0-0) 3 cr.

Bibliografia: Veldman - FORTRAN Programming for the Behavioral Sciences.

ANNEX II

BRAZILIAN UNIVERSITIES

- Universidade Federal do Rio Grande do Sul
- Universidade Federal do Paraná
- Universidade Federal de Santa Catarina
- Universidade Estadual de Campinas
- Universidade de São Paulo
- Universidade Federal do Rio de Janeiro
- Instituto Militar de Engenharia
- Universidade Federal de Minas Gerais
- Universidade Federal e Católica de Goiás
- Universidade Federal da Bahia
- Universidade Federal da Paraíba
- Universidade Federal de Pernambuco
- Universidade Federal do Ceará

RESEARCH CENTRES

- Comissão de Atividades Aéreo Espaciais
- Centro Brasileiro de Pesquisas Físicas

ENTERPRISES

- SERPRO (Serviço Federal de Processamento de Dados)
- PETROBRÁS
- ELETROBRÁS
- SUDENE

A N N E X III

PUBLICATIONS IN 1968

Publications in Brazil

- CÁLCULO AUTOMÁTICO DE DISTÂNCIAS EM FERROVIAS (SUCESU)
  author: A. L. Furtado

- ENSINO DE CIÊNCIA DE COMPUTADORES NA UNIVERSIDADE (SUCESU)
  author: C. J. P. Lucena

- SISTEMA INTEGRADO DE ADMINISTRAÇÃO ACADÊMICA (SUCESU)
  author: R. C. B. Silva

- SISTEMA ISSO (SUCESU)
  author: R. C. B. Silva

- SIMULAÇÃO DISCRETA (SUCESU)
  author: L. C. Martins

- ORGANIZAÇÃO E CONTRÔLE DE UTILIZAÇÃO DE UM CENTRO DE PROCESSAMENTO DE DADOS CIENTÍFICO (SUCESU)
  author: D. S. Dias

PUBLICATIONS IN 1969

1. MONOGRAPHS

1. CONVERSION FROM BNF TO SYNTAX-GRAPH AND SYNTAX-GRAPH REDUCTIONS
   Author: R. C. B. Silva

2. AN INTERATIVE COMPUTER SOLUTION FOR THE EQUATIONS OF ELASTIC WALL-GIRDERS
   authors: J. Mason and J. R. R. Santos

3. FORMULA MANIPULATION IN THE FLETCHER AND POWELL OPTIMIZATION METHOD
   authors: A. L. Furtado and R. Freire

4. SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS BY THE TAYLOR SERIES METHOD USING FORMULA MANIPULATION
   author: A. L. Furtado

5. ON THE BROOKER-MORRIS EXPRESSION RECOGNITION ROUTINE
   author: S. E. R. Carvalho

6. A SOFTWARE WRITING SYSTEM
   author: C. J. P. Lucena

7. A SLIP APPLICATION: THE CONSTRUCTION OF TURING MACHINES
   author: R. L. Carvalho

8. A RECOGNIZER FOR A PRECEDENCE GRAMMAR
   author: S. E. R. Carvalho

9. IDENTIFICATION OF MINOR SUBSETS PERTAINING TO A MAJOR SET THROUGH SIMULTANEOUS ANALYSIS OF RANDOM SAMPLES
   author: A. L. Puccini

10. SEEPAGE IN EARTH DAMS WITH HORIZONTAL FILTER
authors: F. O. Franciss and A. L. Puccini

11. DISCRETISATION ET RESOLUTION NUMERIQUE DE L'EQUATION DES ONDES
authors: J. R. R. Santos et al

12. A FINITE ELEMENT COMPUTER PROGRAM FOR PLANE ELASTICITY WITH CONSIDERATION
authors: J. R. R. Santos and J. Mason

2. PUBLICATIONS IN BRAZIL

3. PUBLICATIONS ABROAD

- BRANCH AND BOUND AND APPROXIMATE SOLUTIONS TO THE CAPACITATED PLANT PROBLEM (Operations Research)
author: Graciano Sá

(*)- FORMULA MANIPULATION IN THE FLETCHER AND POWELL OPTIMIZATION METHOD (JCMCAD)
author: A. L. Furtado

4. BOOKS

- AN AGREEMENT FOR A SERIES OF BOOKS IN COMPUTER SCIENCE WAS ESTABLISHED BETWEEN PUC AND AO LIVRO TÉCNICO S. A.

(*) also published as a monograph

PUBLICATIONS IN 1970

1. MONOGRAPHS

1. A TWO-LEVEL NEWTON METHOD FOR FUNCTION OPTIMIZATION
   author: A. L. Furtado

2. A FORTRAN PROGRAM TO SOLVE THE ASSIGNMENT PROBLEM
   author: A. L. Puccini

3. COMPUTATION COMPLEXITY AND GODEL'S INCOMPLETENESS THEOREM AND TO A MATHEMATICAL DEFINITION OF 'LIFE'
   author: G. J. Chaitin

4. A LOW-LEVEL MATHEMATICAL PATTERN-MATCHING ALGORITHM
   author: A. L. Furtado

5. BASIC FUNCTIONS FOR HANDLING BINARY TREES
   author: A. von Staa

6. THE SPARSE SYSTEM
   authors: C. S. Salim and H. K. Salim

7. TRANSFORMATIONAL GRAMMARS AS MODELS FOR NATURAL LANGUAGES
   author: S. M. Santos

8. THE COMCOM SOFTWARE WRITING SYSTEM
   author: A. von Staa

9. EIGENFUNCTION PROPAGATION IN INTERCONNECTED SYSTEMS
   authors: L. Kerschberg and W. W. Happ

10. AN APPROACH FOR MAPPING ABSTRACT INFORMATION STRUCTURES ON DIGITAL COMPUTER MEMORIES
    author: C. J. P. Lucena

11. RECURSIVE TECHNIQUES IN DYNAMIC PROGRAMMING
    author: A. L. Furtado

12. ON THE USE OF PUSHDOWN AUTOMATA FOR THE PARSING OF SENTENCES OF CONTEXT--FREE LANGUAGES
    author: R. L. Carvalho

2. PUBLICATIONS IN BRAZIL

- UMA EXTENSÃO DA LINGUAGEM FORTRAN IV (SUCESU)
  authors: S. S. Toscani and A. L. Furtado

3. PUBLICATIONS ABROAD

- COMPUTER EDUCATION IN DEVELOPING COUNTRIES: THE BRAZILIAN EXPERIENCE (IFIP Congress on Computer Education)
  author: C. J. P. Lucena

(*)- EIGENFUNCTION PROPAGATION IN INTERCONNECTED SYSTEMS (Allerton)
  author: L. Kerschberg

4. BOOKS

- INTRODUÇÃO ÀS ESTRUTURAS DE INFORMAÇÃO (Ao Livro Técnico)
  author: C. J. P. Lucena

PUBLICATION IN 1971 (until September 1971)

1. MONOGRAPHS

1. PREVENTIVE MAINTENANCE SCHEDULING ON AN EQUIP[redacted]
   author: L. C. Martins

2. PUCMAT - A PROGRAMMING MODULE FOR ARITHMETIC PATTERN-MATCHING
   author: A. L. Furtado

3. DIOPHANTINE SYSTEMS AND APPLICATIONS
   author: H. Quintella

4. A COMPARATIVE STUDY OF SYMBOL TABLES
   author: M. P. Brown

5. URBAN TRAFFIC UNDER COMPUTER CONTROL: A LOGICO MATHEMATICAL VIEW
   authors: L. Kerschberg and R. Skandera

6. ON THE CONSTRUCTION AND MINIMIZATION OF FINITE STATE AUTOMATA
   authors: M. R. Millan and R. L. Carvalho

7. GRAPH-PROCESSING WITH LISP
   authors: M. T. Ribeiro et al

8. PROCESS OF REDUCING FIGURES INTO GRAPHIC STRUCTURES: MINIMIZATION AND CONTINUITY OF GRAPH PATHS
   author: L. A. Hess

2. PUBLICATIONS IN BRAZIL

(*)- GRAMÁTICAS TRANSFORMACIONAIS COMO MODELOS MATEMÁTICOS PARA LINGUAGENS NATURAIS (SUCESU)
author: S. M. Santos

- DEMONSTRAÇÃO AUTOMÁTICA DE TEOREMAS (SUCESU)
author: E. P. L. Passos

- SOLUÇÃO DE EQUAÇÕES DIFERENCIAIS POR MÉTODOS PARTICULARES DE PREDIÇÃO-CORREÇÃO (SUCESU)
author: T. F. Chaves

- PERSPECTIVAS DE UM ENFOQUE DIOFANTINO PARA RESOLUÇÃO COMPUTACIONAL DE PROBLEMAS DE PROGRAMAÇÃO INTEIRA (SUCESU)
author: H. Quintella

- DIOPHANTINE SYSTEMS AND APPLICATIONS (União Geográfica Internacional)
author: H. Quintella

3. PUBLICATIONS ABROAD

- GUIDELINES FOR ORGANIZING THE COMPUTING ACTIVITIES OF A UNIVERSITY IN A DEVELOPING COUNTRY (LACACI)
authors: C. J. P. Lucena and L. C. Martins

(*)- ESTUDO COMPARATIVO DE TABELAS DE SÍMBOLOS (LACACI)
author: M. P. Brown

- UM MÉTODO GERAL DE REPRESENTAÇÃO DE ESTRUTURAS DE INFORMAÇÃO: ESTRUTURA MODULAR (LACACI)
author: L. F. Cunha

(*)- ON THE CONSTRUCTION AND MINIMIZATION OF FINITE STATE AUTOMATA (LACACI)
authors: M. R. Millan and R. L. Carvalho

- A MODELING TECHNIQUE IN PROGRAMMING (Asilomar)
authors: C. J. P. Lucena and L. F. Cunha

- SOME RESULTS ON TIME-VARYING LANGUAGES (Asilomar)
author: S. R. P. Teixeira

- A SET OF PROGRAMS TO TEST AND PARSE LL(k) TYPE LANGUAGES (Asilomar)
author: L. T. Macedo

(*)- AN APPROACH FOR MAPPING ABSTRACT DATA STRUCTURES ON DIGITAL COMPUTER MEMORIES (IEEE)
author: C. J. P. Lucena

(*)- PREVENTIVE MAINTENANCE SCHEDULING ON AN EQUIPMENT (IMS)
author: L. C. Martins

4. BOOKS

- PROGRAMAÇÃO FORTRAN PARA ESTUDANTES DE CIÊNCIAS E ENGENHARIA (Ao Livro Técnico)
authors: D. S. Dias, A. Lucena, F. F. Lima

- CURSO DE CÁLCULO NUMÉRICO (Ao Livro Técnico) - to appear
author: V. R. Santos

- ANÁLISE NUMÉRICA (Ao Livro Técnico) - to appear
author: P. Albrecht

- TEORIA DOS GRAFOS APLICADA (Ao Livro Técnico) - to appear
author: A. L. Furtado

COMPUTER SCIENCE AT THE

FEDERAL UNIVERSITY OF RIO DE JANEIRO

1. Past of Computing in the Federal University of Rio de Janeiro.

The activities of computation in the University are relatively new. They started, in 1967, in the Graduate Engineering School (Coordination of Graduate Engineering Programs (COPPE) where the first digital computer was installed. The small scientific computer, the IBM-1130, began its operation, in february, in the so-called Scientific Computation Department (DCC). This program was the only non-academic program at COPPE. Its main objective was to support the academic and research activities, as a computing center. Many development and research works were done with the use of this computer. Since the beginning, a large teaching activity has been going on under the supervision of DCC but, all of it related to the use of the machine. Introductory, language and operating system courses have been regularly offered as weekly-long intensive optional courses. From 1969 on, a small academic activity, in the software area started in the Electrical Engineering Program provided by the staff members of DCC. This activity was later absorbed and enlarged by the recently created Systems Engineering Program still with the participation of the DCC staff. In middle 1970, the aquisition of a medium-scale computer, the IBM-360/40, has helped the initial installation of the Nucleus of Electronic Computation (NCE), the University Computing Center. The NCE, which is in Operation since december 1970, has been a natural enlargement of DCC and is now providind computing services to the whole community, which was already being done on a limited basis. The creation of the NCE was favorably coincidental with the creation of the Systems Engineering Program. The number and variety of the intensive courses was proportionaly enlarged and the curricular activity at the undergraduate level was made possible.

A course on Introduction to Computing was, for the first time, required to physics sophomore students. In 1972, this course, besides being required to the these students, will also be required to Mathematics Institute students which include all the freshmen and sophomore engineering students. Another course following this, Introduction to Computers, will be offered to the same students on a more limited basis. The traditional Numerical Calculus course, given by the Mathematics Institute, is being completely restructured.

Although, the computing activity is divided among the NCE, Mathematics Institute and COPPE, the development has been perfectly harmonious and complementary.

2. Intensive Courses

These courses are under the NCE supervision. The objective is to provide a quick access to the computer to all professors and students interested in the use of the machine, while the curricula of the courses have not been adapted yet. From the table below it can be seen the great interest arisen whith these courses which are offered as extracurricular activity. It is important to mention that because of physical location most of the use comes from the Engineering students (all the Arts, Human Sciences, Law and Economics Schols are located downtown in the old campus).

TABLE I

YEAR	COURSE	Nº OF CLASSES	Nº OF STUDENTS	TOTAL OF STUDENTS
1967	FORTRAN	7	467	467
1968	FORTRAN	17	1206	1206
1969	FORTRAN	22	1972	1998
	ASSEMBLER	2	26	
1970	FORTRAN	20	1180	1975
	BASIC	11	656	
	ASSEMBLER	4	109	
	COBOL	1	30	
1971 UNTIL OCTOBER	BASIC	19	1405	2339
	FORTRAN	12	634	
	COBOL	2	80	
	PL/I	1	30	
	OS/360	5	190	
				7985

It is being planned for 1972 a core of extension courses for graduates to fullfill the great demand of the market for analists. These courses will be run under the supervision of NCE.

3. Undergraduate Courses

As it has been said this activity started in 1971 for the first time. The course Introduction to Computing was required to all sophomore physics students and it was given in two semester to 150 students each. Next year besides these classes, the same courses will be required to all students in the Mathematics Institute, which means about 500 studentes (this includes all engineering students). Another course Introduction to Computaters, - having the first as pre-requisite, will be offered to 100 students. Another course Numerical Calculus, is being completely restructured and will require Introduction to Computing as prerequisite. This course is also given every year to about 500 students. The enlargement of the graduate Program will be most benefitial to the undergraduate activity.

It is noped, in the next two years, to have computing as one option in the Electrical Engineering undergraduate course. This will be the natural development of the extension courses mentioned which will be gradually absorbed in the regular curricula.

4. Graduate Program

4.I. Introduction

The purpose of this portion is to describe, in a brief manner, the present state of the Programa de Engenharia de Sistemas at COPPE and

enumerate the various possibilities of cooperation with American Institutions, having as goals the expansion of the study of System and Computer Sciences at COPPE/UFRJ and the enrichment of the professional experience of the participants from both countries.

4.II. Present State of the Program

A. The forming of the Program

The Programa de Engenharia de Sistemas was formed as a result of the growth of faculty and student interest in the area, very noticeable in the past four years. It existed last May, 1970, in embryonic form, within the Programa de Engenharia Elétrica, where it had grown to proportions which were starting to create problems. The visit of Prof. L. Zadeh, from the University of California at Berkeley, in Sept. 1969, had helped jell the concept in the minds of the faculty members involved, and when Prof. C.R. Souza from the University of Notre Dame, arrived in June, 1970, to chair the Program, it already existed de facto if not de jure. Under his direction the Program has rapidly taken shape and assumed its identity.

The first group of new students has registered in the Program in March 1971. The Program now counts with over 65 Graduate Students. About half of these is composed of full-time students that come from universities all over the country. The other half is composed of part-time students from local industry.

B. Areas of Activity

The Program offers the Master's and the D.Sc. degrees in the following general areas:

General Systems Theory
Communications Theory

Mathematical Programming, Control and Optimization
Artificial Intelligence
Information Theory and Coding
Automata Theory and Computability
Computer Organization and Design
Data Processing, Computer Programming and Applications

It has strong activities and interests in all but the fourth and fifth, were it is somewhat weak. Present and future visitors are being used to awaken interest and reinforce the Program in these areas. The last two, though very popular with students, suffer from the lack of qualified senior personnel to direct research and supervise doctoral candidates in their theses. We shall return to this point in part III of this document.

C. Present Faculty

1. Full time

Name	Interests
Celso de Renna e Souza (Ph.D.,Univ.Notre Dame,1965)	Logic, Game Theory,Stochastic Processes, Automata, Formal Languages
Amaranto L. Pereira (Dc.Eng.,Toulouse,1959)	Systems Theory, Nonlinear Systems, Multivariable Systems
Nelson Ortegosa da Cunha (Ph.D.,Univ. Calif.,1966)	Systems Theory, Control Sys- Mathematical Programming, Optimization
Denis França Leite (M.Sc.,Purdue Univ.,1967)	Programming Languages,Translators, Operating Systems

Name	Interest
Luciano Pereira (Dr. 3ème cicle, Univ. Toulouse, 1968	Programming Languages, Simulation, Artificial Intelligence
Henri Marchetta (Dr. Ing.,Univ.Paris,1968)	Automatic Control, Computer Control of Industrial Processes
Shanker P. Bhattacharyya (Ph.D. Rice Univ., 1971)	Systems Theory, Control Systems
Andrew Kitshen (Ph.D. Rochester Univ.,1971)	Automata Theory, Algebraic and Topological Techniques in Theoretical Biology
José L.M.Rangel Neto (*) (M.Sc., COPPE, 1966)	Systems Theory, Automata, Formal Languages, Information Retrieval
Demétrio A. Ribeiro (M.Sc., COPPE. 1967)	Systems Theory, Control Systems, Optimization
Clovis C. Gonzaga (M.Sc., COPPE, 1970)	Systems Theory, Mathematical Programming, Control Optimization
Luiz F.L.Legey (*) (M.SC., COPPE, 1970)	Automata Theory, Formal Languages, Optimization
Paulo A. Veloso (*) (M.Sc.,COPPE, 1970)	Systems Theory, Automata, Formal Languages, Computation
João L.M. Saboia (*) (M.Sc. COPPE, 1970)	Systems Theory, Mathematical Programming, Optimization.

Name	Interests
Ivan da Costa Marques (*) (M.Sc.Univ. Calif., 1969)	Recursive Functions, Automata, Formal Languages, Scientific Management of Computational Systems
Guilherme Chagas Rodrigues (M.Sc. COPPE, 1971)	Operating Systems, Compilers, Artificial Inteligence.
Ronaldo C.Marinho Persiano (M.Sc., COPPE, 1971)	Mathematical Programming, Optimal Control, Mathematical Economics
Jayme Luiz Szwarcfiter (M.Sc., COPPE, 1971)	Data Processing, Operating Systems, Information Retrieval
José Antonio Ortega (E.E., PUC-RJ, 1969)	Mathematical Programming, Mathematical Economics
Pedro Salenbauch (E.E., ITA, 1969)	Compilers, Operating Systems, Artificial Inteligence
Ysmar Vianna e Silva Filho (*) (M.Sc., COPPE, 1969)	Automata, Formal Languages, Programming Languages

(*) On leave, at American Universities working towards Ph.D. degree

2. Visiting Professors

Name	Interests
William W. Happ (Electronics Research Center, Mass.) (April 26-July 4, 1970)	Circuit Design, Multiterminal Systems, Computer-Aided Design.
Stephen Coles (Stanford Research Institute) (7/10/1970 - 10/10/1970)	Artificial Intelligence, Computational Linguistics, Problem Solving Strategies
Arthur Gill (Associate Prof., Univ.Calif.) (July 10-August 10,1970)	Finite-State Machines. Formal Languages. Information Theory
Pravin Varaya (Associate Prof. Univ. Calif.) (9/10/1970 - 12/10/1970)	Large Scale Programming Problems, Differential Games, Identification, Estimation and Stochastic Optimal Control.
R.Kalman (Automation Res.Inst.Budapest) (8/10/1970 - 9/10/1970)	Application of Computers to Nonlinear Systems Analysis
Franco Preparata (Dr. Ing.Univ. of Rome, 1959)	Information and Code Theory
Richard Sacks (Ph.D Cornell Univ.1967)	Operator Theory, Graph Theory

3. Technical Cooperation (France)

Pierre Lavelle (Dr.Univ.Toulouse, 1970)
Gerald Banon (Dr.Ing.Toulouse,1971)

D. Computer Facilities

Students have easy access to the EAI TR-20 and EAI TR-48/DCS-30 analog Computers in the "Laboratorio de Automação e Simulação de Sistemas" and to the IBM 1130 digital System in the Scientific Calculation Division: a IBM 360/40 digital System in a very complete configuration was purchased and is in operation since December, 1970. The addition of tele-processing terminals is under way, with several already in operation. The Program is also purchasing a minicomputer for research in time-sharing and real-time control, and a large-scale - hybrid system, for research in System Simulation and Process Control. These facilities should be sufficient in the near future.

E. Interaction with other Programs and Institutions

Since the System and Computer Sciences are interdisciplinary by nature, the Program interacts strongly with: Electrical Engineering (Communications Theory; Control Theory specially control of electric machines and power systems; Electronics, in the realization of both discrete and continuous systems); Production Engineering (Operations Research, Game Theory, Mathematical Programming, Simulation); Bioengineering (modelling and simulation of parts of and interactions among living organisms); Mechanical Enginnering (Dynamical Systems, realizations of hydraulic mechanical and pneumatic systems), etc.

One of the educational policies of the Program is the exchange of information among researchers. This has been acomplished mainly through invited talks which are held weekly. All graduate students are required to attend these talks. This interaction has been most benefitial to the students stimulating their own research and broadenning their views to other areas of study. A complete list of the talks is given below:

1) "Computer Program for Dimensional Analysis", W.W.Happ, Electronics Research Center, Massachussets, U.S.A.

2) "Curricula for a Computer Science Program", D.Cowan, Waterloo University, Canadá

3) "Modal Controllability Structure of Several Variables Linear Sistems", Porter, Salford University, England.

4) "Numerical Control of Machine-tools", J Ikebe, Tokio Institute of Technology, Japan

5) "Approximations and Functional Analysis", J.A.Barroso, COPPE-UFRJ, Rio de Janeiro

6) "Problem Solving Techniques in Artificial Intelligence", L.S. Coles, Stanford Research Institute, U.S.A.

7) "Enumeration of Sets by Diference Equatioons", E.S.Page, New Castle University, England

8) "Lexicographic Ordering", E.S.Page, New Castle University, England

9) "Discrete Optimization", E.S.Page, New Castle University, England

10) "Research Activies in a Computer Science Department", E.S.Page, New Castle University, England

11) "Finite-recall Sequential Machine", A. Gill, University of California, Berkeley

12) "Topics in Formal Languages Theory", S.Teixeira, C.N.A.E., São José dos Campos, São Paulo

13) "Panel Discussion on Computer Science Curriculum", National Academic of Science Commission, Moderator: Celso de Renna e Souza, COPPE-UFRJ

14) "What are Mathematical Models and What Should They Be?, F.Harary, Michigan University, U.S.A.

15) "Hybrid Computation", J.Lutke, Telefunken, Brasil

16) "Industrial Process Identification and His Utilization in Numerical Control", H. Marchetta, C.E.R.C.I., France

17) "Hybrid Computation: Problems and Applications", A.Casteleyn, E.A.I., U.S.A.

18) "Automated Assigment Indexing", C.A.Montgmery, University of California, U.S.A.

19) "Theorems Inversion: Laggrange, Dirichlet and Routh-about Stability", P.Hagedorn, COPPE-UFRJ, Rio de Janeiro

20) "Fuzzy Sets and their Applications", J.P.Jacob, IBM-San Jose, California, U.S.A.

21) "The Forrester Model of a City", P. Varaya, University of California, U.S.A.

22) "Organization and Research Program of the Laboratoire d'Automatique et de ses Applications Spaciales du Centre National de la Recherche Scientifique", G. Giralt, Sub-Director of "LAAS", CNRS, France

23) "A Programming Language APL, the Teleprocessing Language", P.J. Lavelle, COPPE-UFRJ, Rio de Janeiro.

24) "Computational Complexity, A survey", R.M.Karp,University of California, U.S.A.

25) "Topics on Network Queueing", R.L.Disney, University of Michigan, U.S.A.

26) "Possibilities of Operational Research Applications in Brazil", A.R.von Ellenrieder, I.T.A., S.José dos Campos, S.P.

27) "Statistical Decision Theory", S.E.G.Barroso, I.T.A., S.José dos Campos, S.P.

28) "Minicomputers", P.J.Lavelle, COPPE-UFRJ, Rio de Janeiro

29) "Analysis of Traffic Flow in Signalized Arteria", F.P.Preparata, University of Illinois, U.S.A.

30) "An Approach to Large Scale Dynamical Systems", R.Saeks, Notre Dame University, U.S.A.

31) "Small Size Computers", B.Gerbase, IBM do Brasil, Rio de Janeiro

32) "The Administration of a University Computing Center", D.F.Leite, COPPE-UFRJ, Rio de Janeiro

33) "A Modern Minicomputer", M.Fedy, M.Luret, M.Merlo, Compagnie Internationale pour L'Informatique, France

34) "Real Time Classification of Handwritten Script Words", G.M. Miller, University of California, U.S.A.

35) "Modularization and Functional Standardization in Digital Systems", F. P. Preparata, University of Illinois, U.S.A.

36) "A Study of Parameter Estimation Algorithms for adaptive Identification in Real-Time of Linear Processes Disturbed by a Correlated Noise", G. Banon, COPPE-UFRJ, Rio de Janeiro

37) "Bayesian Analysis for the Weiball Distribution", D.A.Bogdanoff, Cleveland State University, U.S.A.

38) "Electrocardiography from the Engineering Point of View", F. Grynszpan, COPPE-UFRJ, Rio de Janeiro

F. Courses

The courses which where offered to the students by the staff of the program since 1970 are listed with the name of the responsable.

1970

ES-101	-	Special Topics in Systems Engineering	Happ
ES-201	-	Special Topics in Systems Engineering	Varaya
ES-105	-	Special Problems in Systems Engineering	Varaya
ES-111	-	Foundation of General System Theory	Lopes Pereira
ES-112	-	Linear System Analysis	Rangel/Ribeiro
ES-113	-	Parametric Continuous Linear System Analysis	Lopes Pereira
ES-121	-	Discrete Stochastic Processes	Renna e Souza
ES-131	-	Communication Systems	Coutinho
ES-132	-	Statistical Theory of Communications I	Coutinho
ES-133	-	Statistical Theory of Communications II	Coutinho
ES-141	-	Linear Control Systems	da Cunha
ES-241	-	Optimal Control Systems	da Cunha
ES-144	-	Linear Programming	Schechtman
ES-145	-	Dynamic and Non-Linear Programming	Gonzaga
ES-243	-	Numerical Methods in Optimization	Restrepo
ES-251	-	Artificial Intelligence	Coles
ES-261	-	Information Theory	Brooking
ES-171	-	Switching Theory	Legey
ES-172	-	Sequential Machines	Legey/Veloso
ES-271	-	Formal Languages	Veloso
ES-272	-	Linear Sequential Machines and Applications	Gill
ES-173	-	Identification Problems in Automata Theory	Gill
ES-081	-	Introduction to Computer Science	Rodrigues
ES-182	-	Computer Organization	Pereira

ES-191	- Programming Languages	França Leite
ES-192	- Compilers	França Leite
ES-193	- Data Structures	Pereira

1971

COS-711	- General Systems Theory	Lopes Pereira
COS-741	- Linear Control Systems	Da Cunha
COS-714	- Introduction to Linear System Analysis	Gonzaga/Rangel
COS-730	- Introduction do Real Analysis/Calculus of Several Variables	Persiano
COS-761	- Introduction to probability Theory	Araujo
COS-746	- Optimization I	Ribeiro
COS-710	- Abstract Algebra for System Engineering	Rangel
COS-771	- Switching Theory	Samir
COS-081	- Introduction to Digital Computing	Damm
COS-791	- Programming Languages	Rodrigues
COS-734	- Elements of Complex variable	Ortega
COS-713	- Parametric Continuous Linear System Analysis	Lopes Pereira
COS-712	- Linear System Analysis	Gonzaga
COS-727	- Foundations of Network Theory	Saeks
COS-742	- Optimization II	Ribeiro
COS-722	- Continuous Stochastic Processes	Baron
COS-721	- Discrete Stochastic Processes	Araújo
COS-726	- Coding and Information Theory	Preparata
COS-720	- Graphs; Network and Matroids	Saeks
COS-782	- Computer Organization I	Pereira
COS-793	- Data Structures	Rodrigues
COS-792	- Translators	Salenbauch

COS-801	-	Special Topics in System Engineering	Preparata
COS-785	-	Operating Systems	Lavelle
COS-081	-	Introduction to Digital Computing	Szwarcfiter
COS-748	-	Numerical Methods in Optimization	Gonzaga
COS-845	-	Filtering, Estimation and Prediction	Banon
COS-841	-	Optimal Control Systems	Bhattacharyya
COS-751	-	Artificial Intelligence	Araújo
COS-771	-	Formal Languages	Kitchen
COS-782	-	Computer Organization II	Pereira
COS-784	-	Teleprocessing	Lavelle
COS-785	-	Operating Systems	França Leite
COS-701	-	Special Topics in System Engineering	Marchetta
COS-801	-	Special Topics in System Engineering	Bhattacharyya
COS-794	-	Analog and Hybrid System Simulation	Babary

G. Presented M.Sc. Thesis to the Program

Here are listed the thesis presented to the Systems Engineering Program:

"Redução de Alguns Problemas de Contrôle Ótimo a Problemas de Programação Matemática", Clovis Caesar Gonzaga, 1970

"Macro Facilidades para um Assembler", José Paulo Favilla Lobo, 1970

"Um Desacomplamento Canônico para Sistemas Lineares Multivariáveis, João Luiz Maurity Sabóia, 1970

"Decomposição Algébrica de Sistemas Causais Aditivos e Multilineares", Paulo Augusto Silva Velloso, 1970

"Estudo de Problemas de Transporte em Rêde com Fluxo Dinâmico", Ronaldo Cesar Marinho Persiano, 1971

"Sistematização do Processamento de Dados - Aplicação em Automação de Bibliotêca" - Jayme Luiz Szwarcfiter, 1971

"Estudo e Implantação de um Compilador SNOBOL", Guilherme Chagas Rodrigues, 1971

H. Presented M.Sc. Thesis to Other Programs at COPPE.

Here are listed all the thesis presented to other COPPE Programs where the Computer was heavily used

"Alguns Métodos de Otimização em Sistemas Discretos e Contínuos", L.F.L. Legey, Luiz Fernando Loureiro, COPPE-UFRJ, 1969

"Modêlo de um Sistema de Recuperação de Informações. Problemas Espistemológicos e Linquísticos Associados", L.R.B.de Oliveira, COPPE-UFRJ, 1969.

"Sôbre a Automatização da Determinação de Linhas de Influência e Envoltarias de Esforços em Pontes", C.H. Holck, COPPE-UFRJ, 1970

"Métodos de Síntese em Mecanismo", J. Maschkvich, COPPE-UFRJ, 1970

"Procedimento Computational de Cálculos e Otimização em Transformadores de Corrente. Estudo Comparativo entre Projetos em Enrolamentos em Cobre e Alumínio", J.F. Queiroz, COPPE-UFRJ, 1970

"Modêlos Estocásticos para Análise e Simulação de Sequência Hidrológicos", D.M. Olive, COPPE-UFRJ, 1970

"Otimização de Projeto de Sistema de Telecomunicação por Tropo-Difusão", E.H.Silva Filho, COPPE-UFRJ, 1970

"O Método dos Elementos finitos: Fundamentos Teóricos, Automatização; Aplicações e Problemas de Placa e de Elasticidade Plana", A. de Vasconcellos Filho, COPPE-UFRJ, 1970

"Simulação Digital de Máquinas Sincronas", A.B.Dinarte, COPPE-UFRJ,1970

"Um Método de Medição Digital de Período de Um Reator-Nuclear", S.G. Mundim, COPPE-UFRJ, 1970

"Determinação de Linhas de Influência, Através de Computador Digital pelo Método das Deformações Impostas", P.J.Sarkis, COPPE-UFRJ, 1970

"Análise por Computadores Digitais de Estruturas Reticulares no Espaço, com Elemento de Seção Variável", N. Charene Filho, COPPE-UFRJ, 1970

"Análise de Pórticos Planos pelo Método da Divisão de Estruturas em Subestruturas", L. F. R. Monteiro, COPPE-UFRJ, 1970

"Uma Investigação Digital de Estabilidade Permanente de Geradores Sincronos", S. Carneiro Jr., COPPE-UFRJ, 1970

I. Recent Publications and Monographies

Here are listed the publications and monographies written by the staff of the program and also by other members of the staff of COPPE where the application of computing is relevant.

"Etude et Realisation d'um Calculateur Statique à Courant Continu", A.L.Pereira, These for Doctor's degree. Universite de Toulouse. Toulouse. France. 1969

"On the Interest of Disciplined Action on Conceptual Coherence Criteria in Dealing With Several Problems in Modern System Theory", A.L.Pereira, Proceedings of the First Analysis of Large Scale Systems. Edited by the Institute of Information Theory and Automation of the Czechoslovak Academy of Sciences, Prague Czechoslovakia, 1970, PE-1.PE-2

"Reflexões sôbre a Noção de Coerência Conceitual e sua Importância no Estudo de Alguns Problemas Básicos de uma Teoria Unificada de Sistemas", A. L. Pereira, COPPE-UFRJ, Rio de Janeiro-GB-BRASIL

"On Reconciling Hartmains and Shannon", C.R.e Souza, Second Hawail International conference on System Sciences, Honolulu, Hawaii, January, 1969

"A Theorem on the State Reduction of Stochastic Machines", C.de R. e Souza, IEEE Transaction on Computers, Volume C.18, Number-5,. May, 1969

"Relationships Among Distinct Models and Notions of Equivalence for Stochastic Finite-State Systems", C.de R. e Souza and R.J.Leake, IEEE Transactions on Computers, Volume C-18, Number 7, July, 1969

"Probabilistic Automata With Monitored Final State Sets", C.de R.e Souza and R. Scholtz, IEEE TRANSACTION ON COMPUTERS, Volume C-20, Number 4, April, 1971

"Probabilities in Context-free Programmed Grammars", C.de R. e Souza, to appear in Information and Control

"Linguagem BASIC para o Computador IBM-1130", P.Salenbauch and M.Olandoski, ITA-Engenharia, Vol.I, n.1, January/February 1970, pags.33-38

"Utilização de Sequências Convergentes de Programas em Programação Conversa", J.L.A.de Araujo, Report to the II Congresso Nacional de Pesquisa Operacional, November, 1969, Rio de Janeiro, GB. Brasil

"Sôbre uma Classe de Sequências Convergentes de Programas Convexos"- Revista Brasileira de Pesquisa Operacional, 1969

"Un Systeme Operationnel Predictif en Multiprogrammation"m P.J.Lavelle, Diplome d'Études Approfundies, Centre d'Informatique, Toulouse, France

"Contribution a la Gestion Automatique d'un Ordinateur", P.J.Lavelle, These de Doctorat de IIIe Cycle, Faculté des Sciences de Toulouse, France

"Tradutor de Linguagem Estatística", Y.V. e Silva Fº, COPPE-UFRJ,1968

"OPSOT - Um Sistema de Métodos Numéricos de Otimização" - P.O.Boaventura Netto, COPPE-UFRJ, 1968

"Abacos para Dimensionamento de Concreto Armado - Flexão Composta - Seção Retangular", F.L.L.B.Carneiro, COPPE-UFRJ, 1968

"SLIP - Processados de Listas Simétricas", R.V.Weeks, COPPE-UFRJ,1968

"TORR-Calculo de Destilação de Misturas Multicomponentes para Computador de Pequena Capacidade", A.A.Rocha, COPPE-UFRJ, 1969

"A Análise de Vigas Contínuas para Computadores Digitais", A.de Vasconcellos Fº, COPPE-UFRJ, 1969

"A Análise de Pórticos por Computadores Digitais", A.de Vasconcellos Fº, COPPE-UFRJ, 1969

"Ensaios Triaxiais" - R.D.Gaudu and A.M.Mahe, COPPE-UFRJ,1970

"O Método dos Elementos Finitos. Fundamentos Teóricos, Automatização; Aplicações a Problemas de Placas e de Elasticidade Plana", A. de Vasconcellos Fº, COPPE-UFRJ, 1970

"Um Método de Síntese de Mecanismos Articulados, Planos, Baseado nas Propriedades do Centro Instantaneo de Rotação e do Rolamento da Centróide Móvel sobre a Centróide Fixa", J. Maschkvich, COPPE-UFRJ,1971

"Cálculo Automático do Efeito do Vento em Estruturas de Edifícios", H.L.Soriano, COPPE-UFRJ, 1971

"Análise por Computadores de Pórticos Planos com Elementos de Eixo e Seção Variável", N.G.Souza, COPPE-UFRJ, 1971

"Análise de Marcos con Nudos Rígidos por el Método de Division en Subestructuras-Formulation Matricial-Aplicacion a Computadores Digitales", L.F.R.Montero, COPPE-UFRJ,1971

J. Sources of Financial Support

The main source of funds for COPPE is the Banco Nacional de Desenvolvimento Econômico (BNDE). The programs of Technical Assistance (OEA, Fulbright, Rockfeller, AID, and European Countries) contribute with qualified personnel. Funds for research and scholarships come from the Conselho Nacional de Pesquisas (CNPq), Coordenação do Aperfeiçoamento de Pessoal de Nível Superior (CAPES) and the Ministério das Relações Exteriores. The UFRJ contributes to the expenses with salaries, maintenance and supplies.

4.III. Present Needs, plans and forecasts

In the Computer Science area the most pressing present need is support in teaching and research. Our present faculty in the area is composed of young men who have just received the M.Sc. degree and a few young doctors. Therefore there is need for senior personnel to support them in the supervision of M.Sc. thesis research, teaching of more advanced courses and to supervise doctoral research. We would need at least one senior member and three more young Ph.D's in the areas listed below

In the medium and long ranges, the needs of the country will certainly be felt. Practically in all sectors of the brazilian economy there are huge masses of data to be processed. For this purpose, specialists in large file organization and data base processing should be formed.

A knowledge of computer organization and design would provide the basis for the development of the electronic industry in computer components, peripherals and eventually computers themselves. Some steps in this direction have already been taken.

Operating systems should be studied because of the increased application of computers in communications, in process control, and other uses; large scale Computer Centers an being installed in ever increasing numbers. Since, because of economical pressures, the computing power may tend to become centralized, operating systems which will permit remote stations in a time-sharing mode will be needed. Further developments may include the connection of large computers in a national network.

The area of Automata Theory and Computability is reasonable well served at present with one Full and four Assistant Professors now working towards Ph.D. degrees abroad, and courses given by short term visiting professors. The addition of a Associate Professor in Formal Languages should be considered.

The area of Information Theory and Coding is badly served, with only marginal interest of three faculty members. Some courses have been given recently by visiting professors. A professor with a Ph.D. in the area is most needed now to supervise these and foster interest on the subject. At least three Assistant Professor would be needed within the next three years.

Interest in Artificial Intelligence is quite high, and has been increassed with the presence of Prof. Stephen Coles, from the Stanford Research Institute, on a 3-month AID contract and Prof. Franco Preparata from the University of Illinois, who came with support from CNPq. To continue the work started by them and by some professors in the staff, at least two members at the rank of Assistant Professor or higher for appointments of at least one year each would be needs. In this areas is a possibility of using special equipment, for which funds would be needed.

Among the first three areas the weakest is by far, Communication Theory, where our only courses are being taught by part-time faculty members, not listed in the above faculty list. To increase the activities in the area one senior member with a Ph.D. degree an two assistants would be needed.

By the end of 1973 Program should count with about 32 (thirty-two) full-time faculty members, roughly distributed as: four to six Full Professors, six to eight Associate Professors, fourteen or less Assistant Professors and six or more Instructors. The expected increase in next few years is summarized in the table.

TABLE II

		1971	1972	1973	1974
NUMBER OF STUDENTS		70	110	140	150
FACULTY	FULL PROFESSORS	3	5	6	7
	ASSOCIATE PROFESSORS	5	7	8	9
	ASSISTANT PROFESSORS	10	12	14	16
	INSTRUCTORS	6	8	10	12

COMPUTER SCIENCE AT UNIVERSITY OF SÃO PAULO

1. PROGRAMS IN COMPUTER SCIENCE

In the University of São Paulo there is not a single Department of Computer Science, but the subject is taken care in the campus of São Paulo by several Departments in the Institute of Mathematics and Statistics, Inst. of Physics, Escola Politécnica. (Engineering School) and in the Institute of Economics and Administration. There are also activities in the field of Computing Science at the School of Engineering in São Carlos and at the School of Agriculture at Piracicaba.

The emphasis varies according to the Institute. At Escola Politécnica and the Institute of Physics the main activity is in the field of hardware. The Institute of Economics main interest is in the area of business data processing and the Institute of Mathematics in Numerical Calculus.

An undergraduate curriculum leading to a B.Sc. in Computer Science is planned to start next year, at the Institute of Mathematics and Statistics.

Several graduate courses are being offered in the field of Computer Science, but so far there is no program leading to a Master degree in Computer Science. There is a M. Sc. in Systems Engineering at Escola Politécnica which comes very near to it, with emphasis, in the design of digital systems.

A Coordinating Committee has been appointed at the University level to establish the policy to be followed in the field of Computer Science, and to run the University Computing Center.

All students in the first year in the area of Science and Engineering do have to take a two semester course in Introduction to Computer and Numerical Analysis. This amount to about 2000 students per semester.

In the graduate programmes there is an enrollment in subjects of Computer Science related fields (Statistics, Operational Research, Applied Mathematics) of about 250 students.

2. RESEARCH

Several research projects are being carried on at USP. At the Institute of Physics a group is designing a CRT display unit with light pen for a Honneywell DDP - 516 Computer and also several interfaces needed to control the Pelletron Nuclear Accelerator.

At Politécnica there is work on digital devices including the development of a typewriter terminal, a Modem, a timer for the IBM 1130 Computer and a CRT display Research is also being made on time sharing using a Hewllet Packard 2000 system. At present this group is finishing the design and construction of a minicomputer for control purposes. At the same department there is also a Micro Circuit Laboratory which is capable of producing many of the circuits for digital work (These activities are presented with greater detail at the annex).

In the field of Software there are researchers working in the support of these hardware activites.

3. COMPUTING FACILITIES

In the main campus at São Paulo the University has the following machines:

IBM/360 model 44 - at the Institute of Physics.

Burroughs B-3500 - (this machine is available only 8 hours daily)

IBM 1130 - at Escola Politécnica

IBM 1130 - at Institute of Economics

Honneywell DDP - 516 at Institute of Physics

Hewllet Packard 2116-B at Escola Politécnica

IBM 1620 at Institute of Mathematics and Statistics.

The Engineering School at São Carlos and the School of Agriculture at Piracicaba have an IBM 1130 each.

4. NEEDS OF THE UNIVERSITY

The main need of the University is personnel of high caliber to help to start a strong and balanced M.Sc. program in Computing Science.

A Ph.D. program should also be started within the next three years.

Every effort is being made to increase the cooperation between the USP activities and others centers in Brasil, through the interchange of personnel and coordination of programs to avoid gaps and duplication of effort.

We estimate that about 5 visiting professors in the field of Computing Science, both hardware and software, would be needed yearly to implement this programme, during the next three years.

ANNEX

EPUSPLSD
UNIVERSIDADE DE SÃO PAULO
ESCOLA POLITÉCNICA
DEP. ENG. DE ELETRICIDADE
LAB. DE SISTEMAS DIGITAIS

INTRODUCTION:

The Digital Systems Laboratory (LSD) belongs to the Department of Electrical Engineering of the Escola Politécnica, the engineering college of the University of São Paulo (USP). It is located on the third floor of the Electrical Engineering Building at the Cidade Universitária, a large campus on the southern edge of the city of São Paulo. The LSD is the focal point of digital computing, both hardware and software, at the Escola Politécnica; and is responsible for both undergraduate and post graduate computer courses.

PERSONNEL:

Presently, the laboratory under the direction of Dr.Antonio Hélio Guerra Vieira is staffed by about fourteen engineers (eight working on advanced degrees), twenty undergraduates on part-time salary (called " estagiários" or apprentices), one secretary and seven technicians. Through correspondence and visits, the laboratory maintains contact with like groups in universities abroad.

It is also customary to have more direct collaboration from abroad, for example Glen G. Langdon,Jr (of IBM and Ph. D. from Syracuse University) is presently participating in the group as a visiting professor.

EQUIPMENT:

The laboratory was started in late 1968 with an IBM 1130 computer. Since then a Hewlett-Packard HP 2016B was added. These systems, which include disks, tapes and line printers, serve all the Escola Politécnica, the university in general, and in certain instances the community (industry, and state and federal organs). Recently-installed on the HP2016B is the BASIC time-sharing system. Also within the laboratory is a shop for making printed circuit cards.

THE UNDERGRADUATE PROGRAM:

Each year, the EE Department graduates 120 to 140 students, of which about half are in "electronics" in general. Of this group, about half will have the "computer science" option. The computer science option, recently approved and currently being phased in, will provide courses in systems architecture, sequential machines, simulation, mathematical programming, information structure, and real-time systems. All EE graduates receive a course in programming, and all students of the Escola Politécnica in their second year, receive a course "Introduction to Computer Science".

POST - GRADUATE PROGRAM

The Laboratory participates in the master's degree and doctor's degree programs of the Escola Politécnica. Within the EE Department, a graduate student may chose " core courses" in " systems engineering" (more software - oriented) or " electronic systems" (more hardware-oriented). Personnel of the laboratory give courses encompassing - switching theory, computer design and microprogramming.(in addition, graduate courses in automata theory and formal languages are taught, by professors not directly associated with the laboratory).

The laboratory has the means to provide support for the master's and doctor's theses in the areas of peripheral and IO interfaces, logic design, software, and programming. Some of the master's thesis topics are covered in the next section.

PROJECTS AND RECENT ACTIVITIES:

Master's thesis projects include an off-line plotter (Calcomp) fed by an inexpensive card reader . The IBM 1130 plotter attachment is very slow, and the resolution of this bottleneck involved a combination of hardware and software.

Another project was a "modem" for sending and receiving digital data over Brazilian telephone lines. Another master's thesis concerns the modification of an IBM Selectric typewriter to convert it to a terminal fed by the modem. These last two projects were key points in a booth at the " First Congress of Applied Technology to Higher Learning " held in Rio de Janeiro, where the attendees participated in remote " time-sharing" via BASIC and ordinary São Paulo-Rio telephone links to the HP2016B. This system was demonstrated to President Médici in July 1971 during a visit to USP. The technology used is the printed circuit (pc) card housing commercially available integrated circuit DIP's and discrete components. Another project concerns a "display" for the IBM 1130. The IBM 1130 is led to believe it is actuating the Calcomp plotter attachment, but the signals actually control an oscilloscope display via a specially designed printed circuit card. Also, a real-time clock attachment was made for the IBM 1130, using the same pc card technology.

At present, most of the people affiliated with the laboratory are involved in one way or another with this project.

THE SMALL CONTROL COMPUTER:

The small control computer project has done much to unify and elevate the "esprit de corps" of the graduate and undergraduate compliments of the laboratory.

The architecture was derived from the graduate students themselves out of a series of homework assignments in a computer design course. The machine is relatively small, with a main memory of 4K of 8-bit words. The data flow is essentially 8 bits wide, binary, as is similar to that of many mini's. The IO bus is also relatively standard. The implementation of the architecture into logic diagrams was done by the graduate - students. The problems of the conversion of the logics to p.c cards, including lay-out, drafting, photography, the chemical processes, and soldering require Brazilian solutions as many " off-the-shelf" items in developed countries are not easily or readily available in Brazil. Interface cards for IO devices are being devised, as well as for the manual controls. The problem of " powering, packaging and cooling" are being faced. Components for the control panel must be selected. Testing procedures at each step (DIP's p.c. cards, card racks, etc.) must be devised. At the other end; items such as documenta - tion programs, wire-wrap listings, simulation at two levels (micro-operation and logic gate), common subroutines, an assembler, and application programs are keeping those with inclinations toward programming-busy. Applications for a computer of this type include that of a data concentrator , controlling slower IO devices for a larger system, control - ling a testing system, and a "key-to-tape" system.

A long-range goal of thisproject is to provide the basis and infrastructure for constructing a more ambitious system. Such a project might possibly utilize dynamic microprogramming and be configurable as a multiprocessor. Such a system could serve as a powerful tool toward applied - research into many topics of interest to computer scientists.

INTERACTIONS:

The digital systems laboratory does not operate as an isolated entity, rather it prefers to interact with others whenever possible. Prof. Vieira's policy is to keep the "doors open". The closest contact is with Microelectronics Laboratory of the same wing of the Electrical Engineering building . The microelectronics lab has about 10 x 24 meters of floor space, with complete facilities from wafers to the finished process (bonding). Recently, the laboratory built the first integrated circuit in Latin America. The microelectronics lab is providing assistance with some of its mask-making capabilities, and some of the microelectronics people are learning some integrated circuit applications by keeping abreast of (and even assisting with) the small control computer project. In turn, the digital system lab plans to help the microelectronics lab in their problems of testing.

A strong area of competance in digital systems exists within the Peletron Particle Accelerator building of the Institute of Physics. The computer group there has, for the most part, received training in the US from computer manufactures. An IBM S/360 Model 44 is used to monitor the particle experiments of the accelerator through a Honeywell 316 computer employed as a data-gatherer. The system, as yet only partially implemented, requires a sophisticated hardware/software approch since it is intended that the S/360 Model 44 also serve as a general-purpose data processor operating under OS/ 360. The Institute of Physis digital systems engineers, also graduate students of the Escola Politécnica, are in frequent contact with the laboratory.

The Digital Systems Laboratory also receives support from the IBM Brasil "Center for Scientific Development". This group has been provided office space within the EE Department, and they help with teaching computer science courses and curriculum development. In 1970, the group helped organize a 2 week computer science workshop.

An organization of computer manufacturing and using corporations is called Sociedade dos Usuários de Computadores e Equipamentos Subsidiários (SUCESU). In October 1971, SUCESU hold a congress at the EE Department building of the Escola Politécnica. Contact was made with SUCESU and the laboratory participated in the technical program of the 3-day conference

SUMMARY:

The objetives of the laboratory can be effectively classified in three broad categories. One objective is the application of computers on-line in control and interactive applications, as exemplefied by the "BASIC" system. A second object is the logic design and implementation of digital systems, as exemplified by the printed circuit card facilities and the thesis projects involving part hardware solutions. A third objective (and the most important) is to pass on practical knowledge and experience (derived in part from the first two objectives) to the students so they may better confront the computer engineering problems unique to Brazilian industry, as exemplified by the wider experience given to the handpicked undergraduate "estagiários" and the newly instituted computer science option. It should be noted that the small control computer project is serving to re-inforce all three of the laboratories objectives.

October, 1971

G.G.L

APPENDIX I

MANPOWER SURVEY OF COMPUTER INSTALLATIONS

IN BRASIL

1. UNIVERSITY INSTALLATIONS

Source: Personal interviews made by CNPq representatives

Legend: G - personnel with B. Sc. degree, working primarily in computing either for the computing centre or computer science department or for other departments.

PG - personnel with Ph. D. or M. Sc. degree, same as above.

T - trainees in the last terms of undergraduate courses.

PT - part time personnel working in industry and engaged in teaching activities at the University.

* - universities expanding their present equipment.

INSTITUTIONS	EQUIPMENT	Personnel G	PG	T	PT
*1. Universidade Federal do Rio de Janeiro	360-40, 1130	11	17	12	-
*2. Pontifícia Universidade Católica do Rio de Janeiro	B-500, 1130, 7044, 1401, 360-40	15	33	40	3
3. Pontifícia Universidade Católica do Rio Grande do Sul	1130	1	-	5	3
*4. Universidade de São Paulo	B-3500, 1620, 3x1130, 360-44	22	14	27	12
5. Universidade do Estado da Guanabara	1130	2	-	2	4
6. Universidade Federal da Bahia	B-500, 1130	2	-	7	2
7. Universidade Federal do Ceará	1130	1	-	2	1
8. Universidade Federal Fluminense	1130	-	-	2	4
9. Universidade Federal de Minas Gerais	1130, 360-40	8	4	30	2
10. Universidade Federal do Paraná	1130	2	-	10	4
11. Universidade Federal de Pernambuco	B-500, 1130	4	-	10	4
*12. Universidade Federal do Rio Grande do Sul	1130	4	3	10	2
*13. Universidade Federal de Brasília	1130	2	-	10	3
*14. Universidade de Campinas	1130	5	5	20	5
15. Universidade Federal de Goiás	1130	2	-	4	-
16. Universidade Federal de Juiz de Fora	1130	2	-	4	-

INSTITUTIONS	EQUIPMENT	Personnel G	PG	T	PT
17. Universidade Federal do Maranhão	1130	1	-	3	2
18. Universidade Federal da Paraíba	2x1130	4	2	10	2
19. Universidade Federal de Santa Maria	1130	2	1	10	1
*20. Universidade Federal de Santa Catarina	1130	2	5	10	1
*21. Escola de Engenharia de São Carlos	1130	8	2	25	5
22. Universidade Federal de Viçosa	1130	7	-	8	-
23. Universidade Federal de Ouro Prêto	1130	2	-	2	-
24. Instituto Técnico de Aeronáutica	1130, 1620	5	3	10	-
25. Fundação Universitária de Bauru	1130	1	-	3	3
26. Instituto Militar de Engenharia	1130	2	5	10	-
27. Escola de Engenharia Mauá	1130	2	-	5	1
28. Instituto Técnico de Alagoas	B-500	1	-	3	1
29. Universidade do Rio Grande do Norte	B-500	1	-	3	1
30. Universidade Federal de Sergipe	1130	2	1	5	1
31. Fundação Getúlio Vargas	1130	3	1	5	2
	T O T A L S	136	106	317	70

2. INDUSTRY INSTALLATIONS

Sources: survey made by the São Paulo branch of SUCESU, in July 1971, in São Paulo, for a sample of 67 installations ranging from IBM 360/20 to IBM 360/65 (the questionaire is given in sequel);

- general informations given by SUCESU.

a. number of computers installed in Brasil up to September 1971..... 630

b. number of new computers per year starting from 1972 (Brazil)..... 200

c. personnel (see function description in sequel) - São Paulo state only.

- systems analysts - total..... 350
  - . senior 153
  - . junior 103
  - . trainees 49
- programmers - total 336
  - . senior 120
  - . junior 165
  - . trainees 72
- operators - total 323
  - . senior 100
  - . junior 144
  - . trainees 79

d. personnel - Brazil

An estimate may be obtained by multiplying the numbers given for São Paulo by 10, and then reducing the result by 20% in view of the development stage of São Paulo in the context of the country.

- systems analysts 2440
- programmers..... 2688
- operators 2584

C I R C U L A R

Nº 7

Assunto : Pesquisa de Mercado

Como é de seu conhecimento, a Sucesu pretende publicar um anuário estatístico de processamento de dados, dando cobertura a tôdas as instalações de processamento de dados, filiadas à Sucesu ou não .

Para a obtenção dos dados que serão usados na publicação do anuário e para atualizar a pesquisa salarial, elaboramos os questionários anexos que pedimos preencher de acôrdo com as instruções que acompanham a presente .

A fim de manter a confidencialidade da parte salarial da pesquisa, incluimos um envelope em branco que deverá ser usado para colocar a parte B - Dados sôbre Pessoal e salários. Na devolução dêsse envelope, V.Sa. receberá um comprovante numerado que servirá para, sem romper a confidencialidade, identificar sua firma e retirar os resultados da pesquisa. As fôlhas B serão codificadas com êsse número e as demais com um código sequencial que será atribuido à sua emprêsa .

Seu tempo dispendido na resposta às questões poderá ser reduzido se V.Sa. tiver à mão as seguintes informações :

Razão social da emprêsa
Endereço
Ramo de atividade
Nome dos representantes junto à Sucesu
Número de empregados da Emprêsa, de Sistemas e de Processamento de Dados
Valor aproximado do faturamento médio mensal atual
A quantidade de funcionários nos cargos pesquisados
Os salários pagos - valor e quantidade de salários pagos por ano civil

O nível de escolaridade e a experiência dos funcionários
Dados sôbre quantidade e modêlo do equipamento
Linguagens de programação
A utilização do equipamento
Dados sôbre o sistema operacional

As colunas "código" não deverão ser preenchidas por V.Sa.. A fim de assegurar uniformidade, a Sucesu fará essa codificação a partir dos dados fornecidos por sua emprêsa .

Solicitamos sua colaboração para com êsse esfôrço da Sucesu, respondendo tôdas as questões e nos devolvendo, ou nos avisando, para retirarmos os envelopes até 09/06/71 .

S U C E S U - P E S Q U I S A 1 9 7 1

ATUALIZAÇÃO DO CADASTRAMENTO DA EMPRÊSA

A pesquisa conterá uma fôlha com a seguinte informação que a Sucesu tem no seu cadastro :

Razão social

Enderêço

Ramo de atividade

Representantes junto à Sucesu

O formulário terá um espaço para que V.Sa. faça as alterações que porventura se fizerem necessárias .

Além das informações acima, solicitamos fornecer :

Número de empregados : Da emprêsa

De sistemas e processamento de dados

Faturamento (ou receita) aproximado médio mensal atual

Nome da pessoa que forneceu as informações

Data

DEFINIÇÃO DE FUNÇÕES PARA ENQUADRAMENTO DE CARGOS

. Análise

1.a. "Analista Senior"

Normalmente responsável pela definição, acompanhamento e implantação de um projeto de sistemas .

Na qualidade de líder, estabelece e coordena o plano de execução do projeto, tendo responsabilidade de supervisão técnica, porém não administrativa, sôbre os analistas e eventualmente os programadores designados para trabalhar no projeto .

Propõe soluções e alterações na rotina operacional das áreas envolvidas pelo projeto .

Estima-se que a experiência necessária em computador seja da ordem de 3 a 4 anos .

1.b. "Analista Junior"

Normalmente sob a supervisão técnica de um analista Senior, procede ao levantamento e análise dos problemas surgidos nos sistemas da emprêsa e participado desenvolvimento de suas soluções.

Colabora com o Analista Senior na execução de suas tarefas .

Estima-se que a experiência necessária em computador seja da ordem de 2 a 3 anos .

1.c. "Analista Trainee"

Normalmente participa do levantamento e análise dos problemas surgidos nos sistemas da emprêsa na qualidade de auxiliar e com a finalidade de adquirir experiência em análise de sistemas .

Sob a orientação de um Analista Senior ou Junior, é em geral solicitado a participar dos aspectos mais simples do trabalho .

Estima-se que, a experiência necessária em computador, seja em torno de 1 ano .

2. Programação

2.a. Programador Senior

Normalmente é encarregado de elaborar os programas de maior dificuldade dentro de um sistema .

cont./

Assiste e orienta os demais programadores nos aspectos de programação, bem como na elaboração da documentação dos programas .

Estima-se que a experiência necessária em computador, seja da ordem de 3 a 4 anos .

2.b."Programador Junior"

Normalmente é assistido pelo Programador Senior na elaboração de programas de maior dificuldade, podendo entretanto elaborar independentemente, programas menos complexos .

Estima-se uma experiência necesária em computador da ordem de 2 a 3 anos .

2.c."Programador Trainee"

É constantemente assistido pelos outros programadores nas tarefas que lhe são atribuídas, desenvolvendo em geral os trabalhos de menor importância na área de programação .

Estima-se uma experiência necessária em computador, em torno de 1 ano .

3. Operação

3.a."Operador Senior"

Normalmente opera e controla o equipamento de computação .

Prepara o computador para a execução dos programas e para o completo atendimento aos trabalhos a serem processados .

3.b."Operador Junior"

Normalmente sob a supervisão do Operador Senior, executa as tarefas de operação do equipamento, que lhe são atribuídas .

Estima-se uma experiência necessária em computador da ordem de 1 ano .

3.c."Operador Trainee"

É constantemente assistido pelos demais operadores em tarefas que lhes são atribuídas, desenvolvendo em geral, trabalhos de menor importância na área de operação .

-o-o-o-

S U C E S U - P E S Q U I S A 1 9 7 1

DADOS SÔBRE PESSOAL E SALÁRIOS DO CPD

A pesquisa terá uma fôlha para cada um dos seguintes cargos :

01 - Analista Senior
02 - Analista Junior
03 - Analista Trainee
04 - Programador Senior
05 - Programador Junior
06 - Programador Trainee
07 - Operador Senior
08 - Operador Junior
09 - Operador Trainee
10 - Perfurador (a)
11 - Conferidor (a)

Para cada um dos cargos deverá ser informado:

A quantidade de funcionários
Os salários pagos :

O menor
A média aritmética
O maior
A quantidade de salários pagos em um ano civil

A escolaridade:

Quantos funcionários têm curso primário apenas, quantos o curso secundário, etc.

A experiência :

O número de anos de experiência na função dos funcionários

A menor
A média aritmética
A maior

Para enquadrar seus funcionários nos cargos pesquisados recomendamos usar as descrições anexas . Essa medida permitirá padronizar os cargos e fazer com que os índices que serão publicados tenham real significado das faixas de salários .

DADOS SÔBRE O PESSOAL E SALÁRIO

01 - ANALISTA SENIOR	B
	QUANT.

MÉDIA ANUAL DE SALÁRIOS	
MENOR	Cr$
MÉDIO	Cr$
MAIOR	Cr$
QUANT. SALÁRIOS ANUAIS (INCLUSIVE 13º)	

ESCOLARIDADE (QUANT. DE FUNCIONÁRIOS)	
PRIMÁRIA	
SECUNDÁRIA	
CURSANDO SUPERIOR	
SUPERIOR COMPLETO	
SUPERIOR INCOMPLETO	

EXPERIÊNCIA (EM ANOS)	
MENOR	
MÉDIA	
MAIOR	

DADOS SÔBRE O PESSOAL E SALÁRIO	B	
02 - ANALISTA JUNIOR	QUANT.	

MÉDIA ANUAL DE SALÁRIOS	
MENOR	Cr$
MÉDIO	Cr$
MAIOR	Cr$
QUANT. SALÁRIOS ANUAIS (INCLUSIVE 13º)	

ESCOLARIDADE (QUANT. DE FUNCIONÁRIOS)	
PRIMÁRIA	
SECUNDÁRIA	
CURSANDO SUPERIOR	
SUPERIOR COMPLETO	
SUPERIOR INCOMPLETO	

EXPERIÊNCIA (EM ANOS)	
MENOR	
MÉDIA	
MAIOR	

DADOS SÔBRE O PESSOAL E SALÁRIO	B	
03 -- ANALISTA TRAINEE	QUANT.	

MÉDIA ANUAL DE SALÁRIOS	
MENOR	Cr$
MÉDIO	Cr$
MAIOR	Cr$
QUANT. SALÁRIOS ANUAIS (INCLUSIVE 13º)	

ESCOLARIDADE (QUANT. DE FUNCIONÁRIOS)	
PRIMÁRIA	
SECUNDÁRIA	
CURSANDO SUPERIOR	
SUPERIOR COMPLETO	
SUPERIOR INCOMPLETO	

EXPERIÊNCIA (EM ANOS)	
MENOR	
MÉDIA	
MAIOR	

DADOS SÔBRE O PESSOAL E SALÁRIO	B	
04 - PROGRAMADOR SENIOR	QUANT.	

MÉDIA ANUAL DE SALÁRIOS	
MENOR	Cr$
MÉDIO	Cr$
MAIOR	Cr$
QUANT. SALÁRIOS ANUAIS (INCLUSIVE 13º)	

ESCOLARIDADE (QUANT. DE FUNCIONÁRIOS)	
PRIMÁRIA	
SECUNDÁRIA	
CURSANDO SUPERIOR	
SUPERIOR COMPLETO	
SUPERIOR INCOMPLETO	

EXPERIÊNCIA (EM ANOS)	
MENOR	
MÉDIA	
MAIOR	

DADOS SÔBRE O PESSOAL E SALÁRIO	B	
05 - PROGRAMADOR JUNIOR	QUANT.	

MÉDIA ANUAL DE SALÁRIOS	
MENOR	Cr$
MÉDIO	Cr$
MAIOR	Cr$
QUANT. SALÁRIOS ANUAIS (INCLUSIVE 13º)	

ESCOLARIDADE (QUANT. DE FUNCIONÁRIOS)	
PRIMÁRIA	
SECUNDÁRIA	
CURSANDO SUPERIOR	
SUPERIOR COMPLETO	
SUPERIOR INCOMPLETO	

EXPERIÊNCIA (EM ANOS)	
MENOR	
MÉDIA	
MAIOR	

DADOS SÔBRE O PESSOAL E SALÁRIO	B	
06 - PROGRAMADOR TRAINEE	QUANT.	

MÉDIA ANUAL DE SALÁRIOS	
MENOR	Cr$
MÉDIO	Cr$
MAIOR	Cr$
QUANT. SALÁRIOS ANUAIS (INCLUSIVE 13º)	

ESCOLARIDADE (QUANT. DE FUNCIONÁRIOS)	
PRIMÁRIA	
SECUNDÁRIA	
CURSANDO SUPERIOR	
SUPERIOR COMPLETO	
SUPERIOR INCOMPLETO	

EXPERIÊNCIA (EM ANOS)	
MENOR	
MÉDIA	
MAIOR	

DADOS SÔBRE O PESSOAL E SALÁRIO	B
07 - OPERADOR SENIOR	QUANT.

MÉDIA ANUAL DE SALÁRIOS	
MENOR	Cr$
MÉDIO	Cr$
MAIOR	Cr$
QUANT. SALÁRIOS ANUAIS (INCLUSIVE 13º)	

ESCOLARIDADE (QUANT. DE FUNCIONÁRIOS)	
PRIMÁRIA	
SECUNDÁRIA	
CURSANDO SUPERIOR	
SUPERIOR COMPLETO	
SUPERIOR INCOMPLETO	

EXPERIÊNCIA (EM ANOS)	
MENOR	
MÉDIA	
MAIOR	

DADOS SÔBRE O PESSOAL E SALÁRIO	B	
08 - OPERADOR JUNIOR	QUANT.	

MÉDIA ANUAL DE SALÁRIOS	
MENOR	Cr$
MÉDIO	Cr$
MAIOR	Cr$
QUANT. SALÁRIOS ANUAIS (INCLUSIVE 13º)	

ESCOLARIDADE (QUANT. DE FUNCIONÁRIOS)	
PRIMÁRIA	
SECUNDÁRIA	
CURSANDO SUPERIOR	
SUPERIOR COMPLETO	
SUPERIOR INCOMPLETO	

EXPERIÊNCIA (EM ANOS)	
MENOR	
MÉDIA	
MAIOR	

DADOS SÔBRE O PESSOAL E SALÁRIO	B	
09 - OPERADOR TRAINEE	QUANT.	

MÉDIA ANUAL DE SALÁRIOS	
MENOR	Cr$
MÉDIO	Cr$
MAIOR	Cr$
QUANT. SALÁRIOS ANUAIS (INCLUSIVE 13º)	

ESCOLARIDADE (QUANT. DE FUNCIONÁRIOS)	
PRIMÁRIA	
SECUNDÁRIA	
CURSANDO SUPERIOR	
SUPERIOR COMPLETO	
SUPERIOR INCOMPLETO	

EXPERIÊNCIA (EM ANOS)	
MENOR	
MÉDIA	
MAIOR	

DADOS SÔBRE O PESSOAL E SALÁRIO	B	
10 - PERFURADORAS /ES	QUANT.	

MÉDIA ANUAL DE SALÁRIOS	
MENOR	Cr$
MÉDIO	Cr$
MAIOR	Cr$
QUANT. SALÁRIOS ANUAIS (INCLUSIVE 13º)	

ESCOLARIDADE (QUANT. DE FUNCIONÁRIOS)	
PRIMÁRIA	
SECUNDÁRIA	
CURSANDO SUPERIOR	
SUPERIOR COMPLETO	
SUPERIOR INCOMPLETO	

EXPERIÊNCIA (EM ANOS)	
MENOR	
MÉDIA	
MAIOR	

DADOS SÔBRE O PESSOAL E SALÁRIO	B	
11 - CONFERIDORAS/ES	QUANT.	

MÉDIA ANUAL DE SALÁRIOS	
MENOR	Cr$
MÉDIO	Cr$
MAIOR	Cr$
QUANT. SALÁRIOS ANUAIS (INCLUSIVE 13º)	

ESCOLARIDADE (QUANT. DE FUNCIONÁRIOS)	
PRIMÁRIA	
SECUNDÁRIA	
CURSANDO SUPERIOR	
SUPERIOR COMPLETO	
SUPERIOR INCOMPLETO	

EXPERIÊNCIAS (EM ANOS)	
MENOR	
MÉDIA	
MAIOR	

SUCESU - PESQUISA 1971

DADOS SÔBRE O EQUIPAMENTO

A pesquisa solicita os seguintes dados sôbre o(s) equipamento(s) utilizado(s) por V.Sa. :

A marca e o modêlo
O tamanho da memória indicando se em K dígitos, K bytes ou K palavras
Os dispositivos especiais, tais como: vírgula flutuante, plotter, compatibilidade, etc .
A quantidade de canais de entrada e saída
Se alugado, comprado ou uso de terceiros
A data de instalação
O sistema operacional usado, no caso de usar mais de um, indicar sòmente o mais usado.
O número de horas pagas por mês separando uso próprio e cedido ou vendido a terceiros
O número de dias em que o CPD é normalmente operado
O número de turno de operação e o horário de início e fim de cada
Se trabalhar em regime normal ou excepcional aos sábados e domingos
As linguagens de programação usadas
As características de cada unidade de entrada e saída:

Os tipos, modêlos e a quantidade.

Na eventualidade de usarem mais de um sistema será necessário preencher uma fôlha C e uma fôlha D para cada um, diferenciando-a pelo número do sistema no local apropiado, com exceção dos periféricos que poderão ser agrupados em qualquer uma das fôlhas D.

UNIDADE CENTRAL - UTILIZAÇÃO - LINGUAGENS | C | |

UNIDADE CENTRAL SISTEMA: _____	CÓDIGO
MARCA :	
MODÊLO :	
* CAPACIDADE DE MEMÓRIA :	
DISPOSITIVOS ESPECIAIS	
QUANT. DE CANAIS DE E/S :	
[1] ALUGADO [2] COMPRADO [3] UTIL.TERCEIROS	
DATA DA INSTALAÇÃO : MÊS _____ ANO _____	
SISTEMA OPERACIONAL USADO :	

U T I L I Z A Ç Ã O	CÓDIGO
MÉDIA DE HORAS CHARGE PRÓPRIO :	
OU RELÓGIO MENSAL P/ TERCEIROS :	
Nº DIAS QUE OPERA NA SEMANA :	
Nº TURNOS QUE OPERA NORMALMENTE :	
HORAS DE CADA TURNO :	
OPERA NORMALMENTE AOS SÁBADOS ? [1] SIM [2] NÃO	
OPERA NORMALMENTE AOS DOMINGOS? [1] SIM [2] NÃO	

L I N G U A G E N S	L I N G U A G E N S
[1] COBOL	[2] COBOL ANS
[3] FORTRAN	[4] PL 1
[5] ALGOL	[6] ASSEMBLER
[7] ASB. BÁSICO	[8] ASB. AVANÇADO
[9] R P G	[10] AUTOCODER
[11] I O C S	[12] S P S
[13] MEAT 1	[14] MEAT 3
[ ]	[ ]
[ ]	[ ]

* VIDE INSTRUÇÕES

80

UNIDADES DE E/S - SISTEMA : _____ | D |

NOME	TIPO	MODÊLO	QUANT.	CÓDIGO
LEITORA CARTÕES				01
PERFURADORA CARTÕES				02
LEIT.PERF.CARTÕES				03
LEIT.FITA PAPEL				04
PERF.FITA PAPEL				05
IMPRESSORA				06
CONSOLE				07
UNID.FITAS MAGNÉT.				08
UNID.DISCOS MAGNET.				09
TELEPROCESSAMENTO (1)				
BANCO DE DADOS (2)				
OUTRAS NÃO ESPECIF.				
PERIFÉRICOS				
PERF. CARTÕES				10
CONFER. CARTÕES				11
GRAV. FITAS MAGNET.				12
PERF. FITAS PAPEL				13

S U C E S U - P E S Q U I S A 1 9 7 1

CINCO PRINCIPAIS SISTEMAS IMPLANTADOS

Pede-se que sejam listadas as cinco principais aplicações comerciais e as cinco principais aplicações científicas implantadas , tomando-se por base as horas de computador utilizadas .

Informar nome, frequência de execução e horas charge ou relógio por mês .

CINCO PRINCIPAIS SISTEMAS COMERCIAIS IMPLANTADOS

E	

N O M E	FREQ. EXECUÇÃO (1)	HORAS CHARGE OU RELÓGIO (2)

CINCO PRINCIPAIS SISTEMAS CIENTÍFICOS IMPLANTADOS

N O M E	FREQ. EXECUÇÃO (1)	HORAS CHARGE OU RELÓGIO (2)

(1) = D DECIMAL, S SEMANAL, M MENSAL, E EVENTUAL, ETC ...

(2) = HORAS EM DECIMAL

APPENDIX II

OUTLINE OF THE PROJECT OF EVALUATION AND FOLLOW-UP OF DATA PROCESSING IN BRASIL

1. With the purpose of evaluating the present situation and dimensioning the future perspectives of data processing in Brasil, the Sociedade de Usuários de Computadores Eletrônicos e Equipamentos Subsidiários (SUCESU) should undertake a National Computer Census.

2. In order to undertake this Census, SUCESU will count with the collaroration of several Brazilian Universities besides public agencies interested in obtaining informations about our situation in data processing.

3. The analysis of the obtained data will provide means to elaborate a data processing policy with respect mainly to the optimization of the existing resources and personnel training.

4. The Census will be undertake through closed modular questionnaires, to be filled with individual assistance, and it will cover the following items (enlarging the preliminary questionnaire given in Appendix I):

   - Type of computer users (own installation, block time, data services, manufacturer, etc.).

   - Equipment (manufacturer, type, configuration, special devices, etc.).

   - Type of utilization (purchase, lease, block time, etc.).

./.

- Time of utilization, specifying new systems and maintenance.

- Programming languages in use.

- Implemented systems (which, and how much machine time is used).

- Software in use (Operating Systems, utility programs, packages, etc.).

- Tele-processing (type in current use and plans for the future).

- Future equipment (type and schedule).

- Personnel (number by specialization, specifying formation and average experience).

- Deficiency of personnel (market problems, lack of experience or formation, etc.).

- Training policy.

- Forecast for personnel increasing (by categories, in the next 5 years).

5. The Census should first be undertaken in the State of Guanabara in January 1972 and in the rest of the Country until June of the next year. It is expected that the Census will be undertaken each three years, being yearly adjusted. In this way the information obtained will remain updated.

APPENDIX III

CPD CENTRO DE PROCESSAMENTO DE DADOS
ESCOLA DE ENGENHARIA DE SÃO CARLOS U.S.P.

Seminário: "A COMPUTAÇÃO NA UNIVERSIDADE"

São Carlos (Est.São Paulo)
24, 25 e 26 Maio de 1 971

Considerando a atual conjuntura do País, quando são mobilizados todos os esforços para o alcance do seu pleno desenvolvimento e considerando a significativa contribuição representada pelo aumento da participação da área da computação eletrônica na multiplicidade de atendimento que pode ensejar como atividade meio e fim, os participantes do Seminário "A COMPUTAÇÃO NA UNIVERSIDADE", realizado em São Carlos em Maio de 1 971, promovido pelo Conselho de Reitores das Universidades Brasileiras, que reuniu cêrca de 26 Universidades com 70 inscritos, recomendam que:

1. Seja o Ensino de Computação, em suas várias modalidades e implicações na comunidade, considerado atividade fundamental e de prioridade maior.

2. Seja dispensado pela alta administração da Universidade, especial atenção à política de pessoal, em todos os seus níveis, face ao atendimento das múltiplas atividades dos seus Centros de Computação e Departamento de Ciências de Computação, de molde a ensejar a contratação em número adequado.

3. Seja dispensado, relativamente nos seus Centros de Computação especial atenção às questões estruturais, assegurando-se, portanto, orçamento próprio, condizente com as necessidades de Computação na Universidade.

CPD CENTRO DE PROCESSAMENTO DE DADOS
ESCOLA DE ENGENHARIA DE SÃO CARLOS U.S.P.

4. Seja criado pelo Conselho de Reitores um grupo tarefa para confecção de um Manual de Dimensionamento de Centro de Computação.

5. Que os participantes, após o Seminário, apoiem a iniciativa relativa à confecção do Glossário de Computação, para final encaminhamento à ABNT, pelo Conselho de Reitores, para ser usado como subsídio a trabalho semelhante em preparação por outros grupos.

6. Seja estabelecida uma política com referência à distribuição e divulgação de "software".

7. Seja dada continuação dos Seminários de Porto Alegre e São Carlos, ainda êste ano, sendo de interêsse que seja no Nordeste. Deverá haver participação mais interdisciplinar, incluindo pessoas das áreas de pedagogia, sociologia, administração, etc. Propõe-se que o título do Seminário, seja :"Seminário de Computação e suas Aplicações na Universidade".

Recomendam, finalmente, que os resultados do presente Seminário sejam levados em consideração nas proposições acima.

São Carlos, 26 de maio de 1.971