

IMPROVING COMPUTER-SCIENCE EDUCATION IN BRAZIL

Rio de Janeiro, Brazil

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Second Report of the NAS - CNPq Study Group on
Computer-Science Education in Brazil
to the

Conselho Nacional de Pesquisas
Brazil

and the

National Academy of Sciences
United States of America

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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 or international 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.

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1. INTRODUCTION AND SUMMARY OF RECOMMENDATIONS

Recognition of the impact of the rapid expansion of computer usage on the Brazilian economy led to an examination of the status of computer sciences in Brazil by the Second Brazil - U.S. Workshop on the Contributions of Science and Technology to Development, held in Washington, D.C., in February, 1968. Subsequent to the workshop a preliminary study of existing computer facilities and future needs in Brazil was made by a two-man team appointed by the Brazilian National Research Council (CNPq) and the U.S. National Academy of Sciences (NAS). The results of their efforts, presented to the Third Workshop convened in Rio de Janeiro in April, 1969, pointed to the importance of computers in Brazil and to the urgent need for policy formulation in this area. The workshop recommended creation of a joint study group to examine immediate and projected requirements for trained computer scientists and technicians and to recommend policies to fill these needs. In May, 1970, two Brazilian members of the study group visited eight U.S. institutions to observe at first hand rapidly changing practices in computer science education and the implications upon computer applications. The full study group, consisting of four participants from the United States appointed by NAS and four from Brazil named by the CNPq, met in Brazil (1) August 10 - 14, 1970; (2) December 10 - 15, 1971; and (3) August 12 - 15, 1972.

At the conclusion of the first two meetings a report was prepared entitled "Recommendations for Improving Computer-Science Education in

Brazil." This report made four specific recommendations to the CNPq:

1. To improve the three main existing computer-science programs,
2. To improve computer-science teaching in other universities,
3. To define the responsibilities of universities and industry with respect to computer science education, and
4. To support the August, 1972, Rio Symposium on Computer Education for Developing Countries.

Chapters 3 - 6 of this current report describe specific programs at three major Brazilian universities that are significant for the establishment of Ph.D. programs. These programs are a response to Recommendation 1. Support for the programs, described in Chapters 3 - 6, is currently the subject of contract negotiation among CNPq, USAID, and AFIPS (American Federation of Information Processing Societies).

Chapter 7 describes a Summer Institute program, and Chapter 8 describes an information-exchange program, both partial answers to Recommendation 2.

As a result of the U.N. report on "The Application of Computer Technology for Development" (E/4800), a Symposium was held on that topic in August, 1971, in Jerusalem. There plans were initiated for a Rio Symposium on Computer Education for Developing Countries to be held August 6 - 12, 1972. The joint study group enthusiastically endorsed the Rio Symposium (Recommendation 4), and all members participated actively in the program. Attendance at this symposium of representatives from 40 countries indicates the importance and widespread interest in this subject.

This report summarizes the actions to implement, at least partially, the major recommendations of the first May, 1972, report. Finally, the study group recommends (Chapter 9) that the joint study group be continued with emphasis on broad responsibility for making policy recommendations on education and training in computer science and computer technology for educational institutions throughout all of Brazil.

Summary of Recommendations, August, 1972

The CNPq-NAS Joint Study Group on Computer-Science Education in Brazil

1. Further endorses Recommendation I of the May, 1972, CNPq-NAS report on the establishment of three (see 2.3 of this report) Ph.D. programs in computer science. Sustained external support for at least 4 years is needed. (See Chapters 2 - 6.)
2. Endorses the establishment of sub-Ph.D. programs at other universities in Brazil, particularly outside the Rio - São Paulo area (see Chapters 2 and 7).
3. Further supports the concept of the Summer Institute as a means of improving regional expertise and using the abilities of visiting experts (Chapters 2 and 7).
4. Recommends the continuation of the CNPq-NAS Joint Study Group with responsibility for reviewing overall computer-science activity throughout Brazil (Chapter 9).

2. NEEDS AND PRIORITIES

2.1 Needs in Brazil

The joint study group's first report of computing needs in Brazil indicates that many current and future national problem areas will require considerable in-depth computing capability to exploit opportunities appropriately for national advancement. One problem area is the analysis of socioeconomic data to help determine governmental policies in health, education, transportation, economic development, and other services. Another is the application of computers in data processing to make resulting government services more effective. Others involve the application of computers in process control, inventory control, finance, etc., to make industry and business more efficient and competitive worldwide.

Could these needs be supplied by straightforward application of computer technology developed elsewhere? Two main factors make the success of such an approach unlikely, particularly in the long run. Brazil's size and socioeconomic uniqueness imply that many computer applications will require a sophisticated knowledge of computer technology to adapt them to Brazilian needs. The rapid pace of computer technology also implies a growing need for large numbers of people able to cope with current problems and to adapt to changing technology. Courses for learning new techniques and concepts will be needed. Further, these two factors will interact in the future to produce an even greater need for large-scale, in-depth competence in computer technology in Brazil.

2.2 Alternative Policies and Recommended Approach

Various alternative policies for meeting the above-mentioned needs were considered, including the establishment and support of

- a. A small number of high-level graduate programs in computer sciences at universities;
- b. A large number of intermediate-level programs at universities;
- c. A large number of intermediate-level in-house programs within the various computer application organizations;
- d. Large numbers of graduate students sent abroad for advanced training; and
- e. Combinations of the above.

The study group's conclusion is that alternative a offers by far the best chance of success. Previous experience in the United States can be cited to support this approach--for example, the success of advanced graduate programs in building up a strong local applications technology base in computers around Cambridge--Massachusetts Institute of Technology (MIT) and Harvard; Philadelphia--University of Pennsylvania, etc.; Los Angeles--University of California at Los Angeles (UCLA), University of Southern California (USC), etc.; and Palo Alto--Stanford. In Brazil, the major necessary condition for success is fulfilled with the existence of three universities (PUC, UFRJ, and USP)* near the take-off point for becoming advanced centers of excellence in computer sciences.

*Catholic University of Rio de Janeiro
Federal University of Rio de Janeiro
University of São Paulo

Where possible, portions of the other alternative approaches should be supported to complement the high-level graduate programs, but none of them, by themselves, represent cost-effective ways of meeting long-term needs. Alternatives b and c imply a high expense and much duplication of effort. Alternative d carries too much risk of losing the best people via the "brain drain"; furthermore, research conducted abroad may not be ideally suited to home needs. Alternative e must be approached with great caution, because of the strong need for concentration of resources to achieve critical mass in the high-level programs.

However, it is very important, particularly in the long term, to provide support and mechanisms for diffusing talent and knowledge from the high-level universities to both the computer-science programs at other universities in Brazil and to applications projects in government and business. One mechanism is the Summer Institute, described in Chapter 7. Another is complementary support within Brazil of B.S. and M.S. level computer-science programs at other universities; another, extension and short-term courses given through the high-level centers to computer people in government and business.

2.3 Scale of Effort

The necessity for concentrating resources is evidenced by the scarcity in other countries of Ph.D.-granting centers of excellence in computer science. The process of building a critical mass of research and teaching talent in computer sciences has been extremely difficult; programs at many institutions have fallen far short of expectations because of an insufficient base of support and concentration of effort.

The joint study group thus recommends support for a maximum of three high-level centers of excellence. Three centers are indicated-- PUC, UFRJ and USP--because a good deal of specialization and interaction is already occurring among these institutions. These conditions of complementarity and relative specialization are necessary long-term conditions for the success of the build-up process.

Long-term external support for a minimum of 4 years is recommended. The support should include senior professors and postdoctoral fellows from the United States to assist in expediting the development of Brazilian research teams and research areas.

2.4. Recommended Strategy

To set and maintain expectations at high levels for both teaching and research, it is recommended that support be provided for one senior U.S. computer scientist and two U.S. postdoctoral researchers to spend 1 - 2 years at each of the three universities. The three visitors at each university will be expected to set an example of high-level teaching and research. Detailed programs and needs of the three universities are given in Chapters 3 - 6.

To provide additional leadership to other Brazilian universities with computer-science programs, it is further proposed that the U.S. visitors act as instructors at an annual 1-month Summer Institute for Brazilian faculty members. This Summer Institute should be rotated among the three Ph.D.-granting universities and be aimed at providing up-to-date graduate and postdoctoral training to faculty members from universities that wish to begin, or improve, existing programs in computer science. Detailed aspects of the Summer Institutes are discussed in Chapter 7.

Time is needed to build up a strong Ph.D. program; therefore, it is recommended that the proposed program of supplying senior professors and postdoctoral fellows from the United States be continued for a minimum of 4 years, possibly followed by a phasing-down period during which Brazilian nationals will take over full responsibility for the research leadership at the three universities.

2.5 Plans Under Way

It now appears that the build-up of the three Ph.D. programs in computer science at PUC, UFRJ, and USP (Recommendation I) will be funded by USAID and CNPq. The administration of the U.S. part of the program will probably be handled by AFIPS, using a new advisory panel whose sole objectives will be to help select the U.S. senior computer scientists and researchers to visit Brazil and to monitor the progress of the program.

3. PROGRAM DESCRIPTION AND BACKGROUND AT THE CATHOLIC UNIVERSITY OF RIO DE JANEIRO (PUC/RJ)

3.1 The Computer Science Department at PUC/RJ

3.1.1 General Background

Computing at PUC/RJ started in 1960 through research and undergraduate teaching. The graduate program in computer science started in the second semester of 1967. The program has so far granted 40 M.Sc. degrees. Of the present 23 faculty members 6 are working for their Ph.D.'s abroad. There are about one hundred graduate students. The areas of research covered by the department include Meta-theory, Programming Languages and Compilers, Computer Systems, Information Storage and Retrieval, Numerical Mathematics, Design of Interfaces between Minicomputers and Large Systems. The computing facilities at the campus include one IBM 7044 and one IBM 370/165.

3.1.2 Background for the Proposed Research Project on Programming Language and Compilers

Since 1960, there has been a great concern with the development of several programming-language compilers, among which are the extended FORTRAN IV for the IBM-7044, the PUCMAT System (symbolic mathematics), the COMCOM compiler for the IBM-7044, the NAP (New Assembly Program for the IBM-1130), the extension of PHI for graph-processing pattern-matching, structured programming, and others. At present, a fast resident PHI compiler for the IBM 370/165 is being developed. Strong research activity is taking place on such topics as practical parsers based on formal language models, semantic definitions of programming languages, data-definition

facilities for programming languages, and some aspects of Algol-68.

3.2 General Description of the Proposed Research Area

The program should include the following areas: latest developments in programming languages (extensible languages), interaction in the design of programming languages and computer architecture (this will work in connection with the São Paulo hardware project), models for semantics of programming languages and their practical applications on compiler generating systems, and sublanguages for special areas of applications.

3.3 Staff Involved*

Sergio R. P. Teixeira (Ph.D.)

Luíz F. A. Cunha (M.Sc.)

Antônio Furtado

(doing thesis work for Ph.D. (in Brazil) for University of Toronto)

Carlos J. P. Lucena

(M.Sc., absent on Ph.D. program, starting January, 1973. Contact element at UCLA)

Suelie M. Santos

(in Brazil finishing thesis work for Stanford Ph.D.)

Arndt Nom Staa

(doing thesis work for Ph.D., expected end of 1973)

Sergio E. R. Carvalho

(finishing thesis work for Ph.D., expected beginning of 1973)

*Includes only the people working in the project area.

Simão S. Toscani (M.Sc.)

Harry Kerschberg (Ph.D.)

Julio Botelho (M.Sc.)

Firmo Freire

(finishing thesis work for Ph.D., expected early 1973)

Indemark

(Ph.D. visiting for 2 years starting March, 1973)

About 30 graduate students

3.4 Complementary Personnel Desired

According to the proposed program, the complementary staff will consist of two junior people and one senior professor to come through the Computer Science Department of UCLA. A faculty member of PUC, who will be at the Computer Science Department of UCLA, will help with the contacts there.

4. PROGRAM DESCRIPTION AND BACKGROUND AT COPPE-UFRJ

4.1 The Systems Engineering and Computing Program at COPPE

4.1.1 General Background

COPPE is the graduate school of Engineering of the Federal University of Rio de Janeiro, Granting M.S. and D.Sc. degrees in 11 different engineering specialties. One program is Systems Engineering and Computing, responsible for teaching and research activities in the areas usually known as Systems Science and Computer Science.

The computing activities at COPPE started in 1967 with a small computer center for the use of COPPE's programs. In 1969 the staff of this center was responsible for the first computing courses taught at COPPE, in the Electrical Engineering program. The development of these efforts was one factor that made it possible to start the Systems Engineering and Computing program in 1970. At the same time, with the acquisition of a new computer, COPPE's computing center became the University Computer Center. Although the academic program and the Computer Center are administratively separated, they work in very close coordination, often with joint appointments of faculty members and joint development of projects.

As a support to the academic activities, the Systems Engineering and Computing Program is forming a laboratory with minicomputers, an analog and a hybrid computer for research in automation, simulation and work related to software design, computer architecture, and real-time control and teleprocessing.

4.1.2 Proposed Research Project on Information Systems: Background

Basically, the Systems Engineering and Computing program had many projects in software design. They were isolated efforts, although they tend to move in the same direction.

The development of software for the initial small machine (IBM 1139) was typical: a macro-assembler, a SNOBOL compiler, and more recently, a resident (in core) FORTRAN compiler. Other works include the development of a system of remote access for the IBM 360/40, the present main computer in the university.

In information systems, a master's thesis was produced on the systematic design of systems; based on it, an automated system of acquisition and control of books was implemented in the local library. At the Computer Center, work has also been done in developing application programs for the university administration, such as a unified system of registration for the whole university.

4.2 General Description of the Proposed Program

To coordinate and guide all the above efforts COPPE proposes to start research in the field of Information Systems Design.

The whole effort should be concentrated on designing systems that take into account the limited computing resources of most installations in Brazil. It would include different aspects of software design, converging all the know-how previously acquired, and starting new lines of research towards the common goal.

The areas covered by this project include the following:

Data structures and file organization and management;

Remote access to a computing facility;

Operating systems and programming languages related to the project; and
Application of information systems.

4.3 Staff Involved

Following are the faculty members who are going to be involved in
this project:

Ysmar Vianna e Silva Filho (Ph.D. 1972)

Denis Franca Leite (M.S. 1967)

Guilherme Chagas Rodrigues (M.S. 1971)

Pedro Salembanch

(B.S. 1969, expected M.S. this year)

Henry Rodney Zacks

(Ph.D. 1972, expected to come by January, 1973)

Ivan da Costa Marques

(M.S. 1969, expected to come with Ph.D. by June, 1973)

François Gallais-Hammono

(Engenheiro Informático--Eng. Inf.--1969, expected January, 1973)

Martin Diamond (Ph.D. 1972, expected January, 1973)

Richard Leake (Ph.D. 1964)

José Manuel Glichera Blum (M.S. 1972)

4.4 Complementary Personnel Desired

One senior visiting professor is desired whose main interest is in
large file organization and management, with secondary interests in opera-
ting systems and programming languages.

Two junior visiting professors are needed with interests in the ap-
plications of information systems and in teleprocessing.

5. PROGRAM DESCRIPTION AND BACKGROUND AT USP

5.1 General Background

The University of São Paulo (USP) does not have a Department of Computer Science as such; the subject is taken care of in several institutes and schools: the Institute of Mathematics and Statistics (numerical calculus), Institute of Physics (hardware), Escola Politécnica (hardware), School of Economics and Administration (business data processing).

The Institute of Mathematics and Statistics is starting an undergraduate curriculum leading to a B.S. in Computer Science. Several graduate courses are offered in computer science, but so far no program leads to an M.S. in Computer Science. An M.S. in Systems Engineering at Escola Politécnica comes very near to it, with emphasis on the design of digital systems. Support is being sought for this activity to upgrade it to doctoral level.

5.1.2 Background of the Proposed Program

Several research projects in hardware design are being carried out at Escola Politécnica. A Digital Systems Laboratory (LSD), established in 1969, has been very active. It has already designed and built several pieces of hardware, such as a real-time clock for an IBM 1130 computer; an off-line plotter to the same computer, with punched-cards input; a modem for data transmission on telephone lines of poor quality; the adaptation of an electric typewriter as a computer terminal; and a CRT display for the 1130.

The group at LSD has just completed the design and construction of a minicomputer for control with a main memory of 4 K words of 8 bits, using

imported microcircuits, and printed circuit cards designed and made at the laboratory. Now working this computer has already stimulated considerable interest in software design. The work is being developed jointly with PUC at Rio.

The group at LSD has also a strong interaction with the hardware group of the Institute of Physics, whose main work is on the design of interfaces for control of a particle accelerator.

5.2 General Description of the Proposed Project

A long-range goal of this project is to provide the basis and the infrastructure for constructing a more ambitious system, possibly utilizing microprogramming, to be configurable as a multiprocessor. Such a system could serve as a powerful tool for applied research in many topics of interest to computer scientists.

5.3 Personnel Available

Helio Guerra Vieira (Ph.D.)
J. J. Angerami (Ph.D., part-time on project)
James Rudolph (Ph.D., visiting professor)
Walter Del Pichia (Ph.D., part-time on project)
Tamio Shimuzu (Ph.D., part-time on project)
A. Dona Porto (Ph.D., part-time on project)
Antonio A. Massola (M.S.)
Lucas Moscato (M.S.)
Francisco Ribeiro (M.S., on leave, taking Ph.D. at Stanford)
L. A. Marzagão (B.S., graduate student)
N. Matos Cunha Jr. (B.S., graduate student)
S. Schimizu (B.S., graduate student)
E. Rauzini (B.S., Assistant Researcher)
S. Stenbinner (B.S., Assistant Researcher)
R. Cintra Ferreira (B.S., graduate student)
S. Kovachs (B.S., Assistant Researcher)
N. Zvanella (B.S., Assistant Researcher)
C. Taniguchi (B.S. Assistant Researcher)
Edson Fregoni (B.S., Assistant Researcher)
W. V. Ruggiano (B.S., graduate student)
F. C. Meirelles (B.S., graduate student)
Marcello Pessoa (B.S., graduate student)
E. Graziani (B.S., graduate student)
S. Gonçalves (B.S., graduate student)
J. José Neto (B.S., graduate student)
B. J. Souto (B.S., graduate student)
M. A. Varella (B.S., graduate student)

5.4 Complementary Personnel Desired

The project should have a senior professor with a background in electrical engineering and experience in hardware design. His work with

little or no lecturing, would be mainly to advise on the Ph.D. program and to orient research and thesis supervision. In addition, two postdoctorate researchers to work in research and be responsible for graduate courses in the area are desired.

6. SUMMARY OF THREE PROPOSED PROGRAMS AT PUC, UFRJ, AND USP

6.1 Table 1

Table 1 on the following page summarizes the level of computer science at the universities. It is clear that the programs listed are on-going, with a reasonable level of staffing and an appropriate number of graduate students. Thus, the support program has an excellent basis for starting, and the prospects of making significant improvements in degree programs and establishing three high-quality Ph.D. programs are very good.

6.2 Complementarity of the Programs

The three programs at PUC, COPPE, and USP are likely to reinforce one another as they evolve because the focal points of the three programs-- hardware, basic software, and information systems--are complementary. Furthermore, the leaders in the university computer science departments show exceptional resolve to combine their skills in joint projects. One project between PUC and USP to develop software for the USP minicomputer is already under way. Another project between PUC and COPPE in the areas of languages and file processing is under active discussion and definition.

6.3 End Results

The end results expected from the effort will be three departments producing research workers and teachers necessary for the continuing health of Brazilian computer science. These teachers will help set up programs in other universities, and provide the leadership necessary for Brazilian computer science to evolve, as it surely will, into new and unpredictable areas in the 1980's.

Table 1. Computer Science at Three Brazilian Universities, August, 1972

	PUC		UFRJ		USP	
Staff: Ph.D.'s	9		10		7	
M.S.'s	14		14		20	
Studying Abroad	6 (out of 14)		5 (out of 14)		10	
Graduate Students	100		100		50	
Visitors	2		4		3	
Short Periods	6				0	
Area where Support is desired	Programming Language and Compilers		Information System Design		Hardware Design	
	Now	'73 Expected	Now	'73 Expected	Now	'73 Expected
Ph.D.'s in area	2	5	1	2	2	3
M.S.'s in area	6	5	4	4	3	6
Visitors in area	0	1	1	3	2	1
Graduate Students	30	30	20	20	25	30
Grad. Studying Abroad	2	1	1	1	1	2
Major Computer	IBM 370/165		IBM 360/40	IBM 360/65	Burroughs B 3500	
Memory size	1000 K		256 K	1000 K		
Disk Size	400 M (3330)		240 M	240 M		
Mag Tapes	2 drives		4 drives	6 drives		
	9 track		9 track	9 track		
	1600 bpi		800-1600 bpi	800-1600 bpi		
	240 kps		120 kps	120 kps		
Card Reader	2 x 1000cpm		2 x 1000 cpm	2 x 1000 cpm		
Printer	2 x 1100lpm		1100 lpm	2 x 1100 lpm		
Other Computers	IBM 7044 IBM 1130		IBM 1130 MITRA 15		IBM 360/44 IBM 1130 H.P. 2000B	
Completed Projects	1130 NAP (New Assembly Program) FORTRAN IV extended compiler COMCOM; Compiler-compiler PUCMAT (Symbolic Mathematics Compiler) Extended PL/I compiler for design Fast PL /I compiler (underway) partial results.		1130 Macro-Assembler 1130 SNOBOL compiler Library Automation 1130 Fortran Resident Compiler Teleprocessing Access Method General Student Registration System General Payroll System		Modem Real Time Clock Off-Line Plotter Mini Computer for Control (4K Memory, 8 bit words. 2u sec cycle).	

7. SUMMER INSTITUTES

One principal recommendation in the study group's previous report was 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." The study group is gratified that CNPq has acknowledged the value of this recommendation and agreed to support internally the proposed Summer Institutes, which would also be indirectly supported by the USAID program through the major participation of visiting U.S. computer scientists.

7.1 Purpose of the Summer Institutes

The aims of the proposed Summer institutes follow:

- To provide advanced seminars in research areas of direct interest to the three universities with significant computer-science studies (PUC, UFRJ, and USP), thereby appraising them in some depth of the latest advances in their primary research areas.

- To teach broader courses in subjects of interest to all faculty members and graduate students in computer science in Brazil, thus raising the general national competence among academicians and professionals.

- To provide a platform whereon Brazilian workers may present their plans, ideas, questions, and results to an interested, critical, and competent audience before submitting them to the international computer community.

- By exciting and interesting bright young students to inspire them to enter computer science where they will find fascinating and complex problems and wide opportunities.

7.2 Previous Similar Experiences in Brazil

Several previous activities in Brazil have provided experiences similar to the Summer Institutes, for example,

- Seminar on the Use of Computers at Universities. Three seminars sponsored by CNPq, two in Rio Grande do Sul and São Paulo in 1971 and one in Paraíba in 1972, lasted for a week and attracted about one hundred students in each case. The format was a symposium on various aspects of computer usage at the university, from curricula to administration.

- Colloquium in Mathematics. Several first courses in computer science were included in these well-known and highly successful colloquia sponsored by CNPq, including Numerical Analysis (1967), Analog Computing (1969), and Theory of Computing (1971). Held in Poços de Caldas, each course was attended by about sixty students who turned in homework, took examinations, and received certificates of completion.

- Symposium on the Training of Physicists in Computing. This program, jointly sponsored by CNPq and CLAF and held in PUC in 1972 and 1973, included intermediate-level courses in Special Numerical Methods, Symbolic Manipulation, Conversational Languages, and Real-Time Computing. About forty students took these courses following the Mathematics Colloquium approach.

- Workshop in Computer Science. Each of these intensive, advanced workshops sponsored by IBM - World Trade in São Paulo (1970) and in PUC (1972) were attended by some forty students.

7.3 Recommended Format

Previous experience has demonstrated the feasibility, popularity, and value of such summer programs. Therefore, the study group recommends that

a systematic program of Summer Institutes in Computer Science be launched as soon as possible. The actual structure of individual programs can generally be left to the direction of the organizers and the host university; however, it is recommended that these programs include the following:

- Courses at Several Levels, for example:

- a. Basic courses aimed at senior undergraduates;
- b. Intermediate courses aimed at beginning graduates; and
- c. Advanced courses aimed at senior graduates.

These courses could be taught over a 1- to 3-week period for some 20 - 30 hours; they would include assignments and examinations, and lead to special certificates. Such courses can well be taught by Brazilian specialists with occasional back-up from foreign visitors.

- Advanced Workshops. These would include advanced, in-depth presentations of research areas of particular interest to Brazilian workers and, especially, to the three universities charged with developing Ph.D. programs. Advanced tutorial sessions and contributed research papers making up the program should be presented by both Brazilian workers and foreign visitors.

- Symposia on Various Areas of Computer Applications. These could also follow the symposium approach, although students might be encouraged to take them as courses. The emphasis would be on breadth in a given area of interest.

7.4 Sample Programs

The following programs are listed as a general suggestion:

COURSES

a. Elementary Courses

On-line programming (APL or Basic including laboratories)

Boolean algebra

FORTRAN, COBOL or PL/I (including laboratory)

b. Intermediate Courses

File organization

Data structures

Advanced utilization of programming languages (FORTRAN, COBOL, PL/I)

Compilers

Foundations of system programming

Simulation

c. Advanced Courses

Comparative analysis of programming languages

Telecommunication and teleprocessing

Management information systems

Operating systems

Applications of LSI

Automata and formal languages

ADVANCED WORKSHOPS

Relational model of data

Minicomputers

Computer systems performance and evaluation techniques

Semantics of programming languages

Computer networks

Graphical systems

COMPUTER APPLICATIONS

Storage and retrieval in library systems

Geographical data bases

Hospital administration systems

Computer-aided design (circuits, structures, etc.)

Computer-aided composition and printing

Privacy and security

8. OTHER PROGRAMS

Several programs under way between CNPq and other institutions abroad aim at supporting the interchange of specialists in computer science between Brazil and other countries. These include the programs with the National Science Foundation (NSF) in the United States, with the Association for Mathematics and Data-Processing (GMD) in Germany, and with the National Research Council of Canada. Those programs are examples of other means by which CNPq is upgrading computer science in Brazil that are compatible with the activities described in this report.

The present project, described in Chapter 2, will also be considered part of the Brazilian tri-annual program to support academic activities in computer science in Brazilian universities to be funded by the National Bank of Development and the Ministry of Planning.

At present, USAID is also considering another project in continuing education. However, this program has different goals from those discussed in this report.

9. THE FUTURE OF THE JOINT STUDY GROUP

During its 2-year life, August, 1970 - August, 1972, the joint study group has examined the state of computer science in Brazil and has made a number of recommendations to CNPq and NAS. As noted in Chapter 2, it now appears that one of the group's most important recommendations, the build-up of three Ph.D. programs in computer science, will be funded by USAID and CNPq. AFIPS will administer the U.S. part of the program, using a new advisory panel whose sole objectives will be to help select the U.S. professors and researchers to visit Brazil and to monitor the progress of the program. Although one or more of the joint study group may become members of the AFIPS advisory panel, the new panel is not a successor to the joint study group and will not address the same broad goals.

Computer-science education covers a broad spectrum of activities from high school through doctoral programs. At each level are activities in both Brazil and the United States that can benefit from a continued exchange of information. Because the AFIPS advisory panel will limit its activities to the Ph.D. programs at PUC, UFRJ and USP, it will address only the top of the educational pyramid. The joint study group, if continued, could concentrate on the subdoctoral programs developing at several Brazilian universities, and on other training activities. Brazil is a large country, and universities outside the Rio de Janeiro and São Paulo areas should be encouraged to develop their own programs as fast as resources permit.

Furthermore, with the installed base of computers in Brazil growing at close to 30 percent per year, manpower needs will be difficult to meet in

the near future. There will, therefore, be a great need to review educational programs continually to ensure their meeting the needs of government and industry to the maximum extent possible; at the same time future needs must not be ignored. Because the skills required by computer professionals in 1980 may be quite different from those of today, steps should be taken to ensure that persons trained today can evolve into those needed tomorrow. The joint study group offers a reasonably objective mechanism for determining whether these needs are being met.

The advantage of continuing the present group lies in the knowledge acquired by its 2-year study of computer-science education in Brazil, highlighted by three meetings in Brazil in August, 1970, December, 1971, and August, 1972. During this period, the study group visited various institutions and met with many different persons. Such knowledge of the Brazilian scene cannot be reproduced in a short time, yet it becomes outdated if not kept current by repeated, at least annual, visits.

The NAS-CNPq Study Group on Computer-Science Education in Brazil, therefore, unanimously recommends to NAS and CNPq that it be kept active and given ongoing responsibility for an annual overall review of Brazilian computer-science activity. Such reviews should include appropriate recommendations for changes in programs or funding.

The joint study group should be independent, rather than vested with operational responsibility for any specific program. The only budget required, therefore, is for annual meetings and associated site visits. Its value lies in its objective overall interest in improving computer-science education in Brazil.

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ANNEX A

A GENERAL SURVEY OF COMPUTING ACTIVITIES IN BRAZIL*

Presented to the Office for Science and Technology of the

United Nations

Section of New Technologies

June 1972

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*With minor editorial changes by the NAS.

INTRODUCTION

At a time when Brazil has the largest and most rapidly growing computing capacity in Latin America, it seems worthwhile to make an appraisal about this area, which is becoming very important to our economy and to analyze its impact on various other areas, such as research, education, government and industry.

The number of computers installed in Brazil at the end of 1971 was 630, and this figure is expected to increase at an annual rate of more than 30 percent. The statistics and estimates given in this work were arduously gathered and adapted from several sources, since only recently efforts were undertaken towards the organization of a systematic set of information on the area of computation in the country. Within the available means, the data were extensively checked.

The reader should view this text from a special viewpoint. The authors are members of a permanent committee of the Conselho Nacional de Pesquisas in charge of the preparation and coordination of a research and education development program in the area of computer science. From this point of view the approach adopted for this text emphasizes more the academic and research areas, the other areas being presented as a general background. In spite of this limited point of view, we believe that a sufficiently broad appraisal of the entire range of the present computation activities in the country was achieved.

1. RESEARCH AND EDUCATION IN COMPUTATION

Although computation in Brazil began in universities (Universidade Católica do Rio de Janeiro, 1960, and Universidade de São Paulo, 1962), in general the education and research oriented computing centers began to develop in the country as late as 1967.

In December, 1971, there were 29 universities in the country, 7 isolated schools (e.g., independent engineering schools) and 4 research centers with computing centers in operation. The number of machines installed, or soon to be installed, in these centers totaled about 70 units.

The majority of these installations consists of small-size machines, some of the largest installed or to be installed being one IBM/270-165, two IBM/370-155, two IBM/370-145, three Burroughs B-6700 and four IBM/360-40.

Most of the computer applications and the specialized education in computer science is being undertaken by three universities in the Rio-São Paulo area. These are the Pontifícia Universidade Católica do Rio de Janeiro, the Universidade Federal do Rio de Janeiro, and the Universidade de São Paulo (the largest university in the country). In these three universities, besides the basic courses in computation for almost all programs offered by the university and the specialized courses for upper-division undergraduates, graduate programs in computer science deserve a special mention: a present enrollment of about 200 students and about 60 M.Sc. degrees already awarded in the specialties of computer science (theory, software, and hardware) and systems engineering.

A sizeable proportion of these graduates are now active in Brazilian universities.

The common characteristics of the three university centers are that they all offer academic programs in computer science at a level equivalent to, say, the average of the similar existing programs in North America, and the fact that each of them is at a stage where its own lines of research are being defined.

Four other universities may be classified at a level immediately below the first three. Although they undertake interesting computer applications and a median education program, significant research problems are not yet being attacked.

A general description applicable to the remaining universities is the following: almost all of them already offer in their curricula elementary computation courses to which a significant proportion of all their students are exposed; a few routine technical and scientific applications are performed; efforts are frequently applied to taking advantage of the computing facilities for administrative tasks of the university, mainly academic administration (registrar, control of credits, etc.), and finances.

To complete the overview of the situation of computation in Brazilian universities, it is worthwhile to mention some data on the personnel working in this area. In what follows a distinction was not made between the personnel dedicated to education and research working exclusively in, for example, computer science departments and the personnel engaged in

computing centers (often this distinction does not exist). The degrees to be mentioned are not, in the large majority of cases, awarded in computer science (an area in which at present the specialists work), the most frequent areas they come from being mathematics, physics, and engineering (mainly electrical).

	<u>NUMBERS</u>
1. Full-time personnel with B.Sc.	140
2. Full-time personnel with M.Sc. or higher degree	140
3. Part-time personnel. Specialists working in industry or government and collaborating with the universities	70
4. Upper-division undergraduates engaged as trainees in computing centers or computer science departments	350
5. Graduate students specifically in computer science	200

A considerable portion of the personnel in 1 and 2 is engaged in the three above-mentioned largest centers (almost 50 percent), as well as all the students in 5. Item 4 provides a safe estimate of the demand for the graduate programs in computer science. It should also be mentioned that two universities in the country have B.Sc. programs specifically in computation and that two others have been acquiring some experience in computer-assisted instruction.

When one observes the general picture of the academic activity, one gets the impression of very good medium-term perspectives. This assertion stems from the following factors:

1. There are government agencies in the country that at present invest considerable sums in the development of activities related to computation in universities and research centers (Conselho Nacional de Pesquisas; Ministério do Planejamento, and Banco Nacional do Desenvolvimento Econômico; Ministério da Educação through its agency (CAPES).

Specially, the Conselho Nacional de Pesquisas maintains an integrated program to support research in computer science in the country that will surely provide a solid foundation for the research in this area.

2. The large number of international agreements specifically oriented towards scientific activities in computer science (almost always coordinated by the Conselho Nacional de Pesquisas) have brought a close contact with other countries' experience, which will help reduce the number of stages in the development of computer science and help to avoid errors in its development in Brazil.

It is also already possible to make a brief estimate of the dividends yielded by the past investments and to enumerate some successes resulting from the recent development of computation in the Brazilian university area.

1. Distinguishable features can already be observed in the information of the new generation of university students that are being exposed to computation courses in their regular curricula.

2. The increasing number of graduate programs in computer science and need for well-trained persons in industry compete for the graduates currently coming from the basic undergraduate programs.

3. The investment made in sending Brazilian students abroad for doctoral work in computer science has also been important to the growth mentioned in 2.

Among the major research centers in the country using computing in their activities (there are no research centers specializing in computer science) the following may be mentioned: Instituto de Pesquisas Espaciais, Centro Brasileiro de Pesquisas Físicas, Instituto de Energia Atômica, Fundação Getúlio Vargas (research in economics), Centro Técnico Aero-Espacial. It is worthwhile to mention as examples of research institutes (each being part of some university) developing real-time experiments in the area of control, the Instituto de Física of the Universidade de São Paulo (the most advanced), the Instituto de Física of the Universidade Federal do Rio Grande do Sul, and more recently the Instituto de Pesquisas Radioactivas in association with the Universidade Federal de Minas Gerais, the Instituto de Física of the Pontifícia Universidade Católica do Rio de Janeiro, and the Instituto de Bio-Física of the Universidade Federal do Rio de Janeiro.

As indicators of the development of the Brazilian science community in the area of computation one could mention the following scientific meetings: seminars on the use of computers in universities (regular program, which already took place three times with representatives from practically all the universities in the country); seminars on the training of scientists in computations; "summer schools" in computer science; and international meetings such as the forthcoming Rio Symposium in Computer Education for Development.

2. COMPUTATION IN THE GOVERNMENT AREA

The government area has also developed very rapidly since 1967.

Special mention should be made of the creation of the SERVIÇO FEDERAL DE PROCESSAMENTO DE DADOS - SERPRO, a public enterprise created by a law of 1964. SERPRO became really operational only in 1967, and since then has grown by 2,000 percent. This enterprise is responsible for the largest part of government data processing. Its budget in 1970 was CR\$ 47 million; it went up to CR \$150 million in 1971 and should reach CR\$ 210 million in 1972. SERPRO employs at present about 4,000 people and operates 11 regional operating units, distributed throughout the entire country. It now owns about 20 computers, most of them medium-size.

Although in principle it should serve all the federal area, SERPRO's activities are preponderantly in the area of the Ministério da Fazenda, specially in processing the income tax.

At present SERPRO is collaborating with the Instituto Nacional de Colonização e Reforma Agrária (INCRA) in drawing the records of rural properties, numbering 4 million, and that should be ready by October, 1972. For the Caixa Economica Federal it is drawing the records and is controlling the contributions of 10 million workers included in the plan for social integration (PIS).

SERPRO also has an extensive educational program, to cope with its own needs.

Besides SERPRO, there are several other computer installations in several ministries and government-controlled institutions.

Within the area of the Ministério do Trabalho e Previdência special note should be made of the INPS, whose data-processing centers handle the social security of 11 million workers, 25 million dependents, and the contribution of 1.3 million enterprises. Its principal centers are interconnected so as to permit data transmission.

Within the area of the Ministério de Minas e Energia note should be made of the computing centers of Petrobrás (one of the major computer users in the government area) and ELECTROBRAS, besides the computers of the Comissão Nacional de Energia Nuclear. These installations, besides administrative processing, perform technical and scientific calculations. Note should also be made in the same area of the Companhia de Mineração Vale do Rio Doce.

Within the Ministério das Comunicações large computers can be found in the area of telephone services (CTB), being used for billing and control tasks.

On March 31, 1971, the Instituto Brasileiro de Informática (IBI) was created: it reports to the Instituto Brasileiro de Geografia e Estatística of the Ministério do Planejamento. The IBI is part of the integrated information, research, and planning system of the Ministério do Planejamento. Some of its specific projects are the processing of the demographic and economic censuses, and the processing of continued statistics; these activities are converging towards the creation of a large socioeconomic data bank. Although very recent, this institution has a staff of approximately 60 analysts and programmers that already operate efficiently a model IBM/370-155, recently installed.

Another important area shared by the government where there is intense data-processing activity is banking, federal as well as state (the Banco do Brasil is also one of the major users of computing in the government area).

In the legislative sphere we must single out the system of legislative information and follow-up of projects of law, that is being implemented by the Senado Federal, in Brasilia. It is one of the first large-scale information retrieval systems to be installed in Brazil.

On the state level several members of the federation have computing services available, the most outstanding being the PRODESP in São Paulo and the data-processing companies in the states of Minas Gerais, Bahia, Paraná, Rio de Janeiro, and Rio Grande do Sul.

Likewise in the municipal area note should be made of the city of São Paulo with the PRODAM and the municipalities of the so-called ABC in São Paulo.

It is calculated that in all about 150 computers are installed in government agencies, that is, approximately 25 percent of the installations in the country. This small proportion comes from the more recent start of the activities in the area as compared with the private area. For this same reason, the rate of growth of the area should be over 30 percent per year in the next triennial period (greater than in the other areas).

Recent data provided by the Ministério do Planejamento indicate that the public administration expenses in the area of computing will

rise to 760 million cruzeiros (about 120 million dollars) in the triennial period 1972 - 74.

Taking into consideration the importance of this area and the need for a plan to establish policies for the new purchases and leases; and attempting to avoid duplications, idleness and poor dimensioning of the equipment, the Comissão de Coordenação de Atividades de Processamento Eletrônico (CAPRE) was created in April, 1972.

The responsibilities of CAPRE are (a) to organize and to up-date records of the installations and their degree of utilization, (b) to give advice on intended new purchases and leases by government agencies, and (c) to suggest measures for governmental financing for the data-processing area. The fact that CAPRE was created is a good indicator of the government's growing concern with computing activities.

3. COMPUTATION IN THE PRIVATE AREA

If the activities of government agencies are not counted, computers in Brazil are mostly used in typical data-processing applications. They are installed in banks, financial institutions, insurance companies, commerce, industries, and service bureaux.

We can say that more than 400 computers, 65 percent of all installed computers, are in the private area. This percentage is less if we consider the value of the equipment. The largest machines are installed in the Bradesco (private bank in the state of São Paulo; IBM/360-65), in the Rio and São Paulo branches of ITT (IBM/360-50). There are more than 20

IBM/360-40's and more than 30 Burroughs B-3500's. The remaining computers consist principally of second generation smaller-size equipment.

All this equipment is used in routine applications in the area of administration and finance. More specifically, the applications include payroll, billing, accounting, and inventory control. The service bureaux perform more or less the same kind of activities under the form of standardized applications for users who still do not have machines. Turning to the bureau, we may single out Datamec, a national enterprise that appears among the largest service companies in Latin America, operating installations with a total of 11 computers in several states of the country.

There is a large demand in the market for programmers and analysts, which inflates the salaries to a very high level, in terms of developing countries. Training personnel is one of the immediate problems to be solved. Apart from a small effort by the manufacturers, only a few bureaux are offering courses, and the quality of such courses is questionable.

There is a growing need for qualified personnel, especially now with the arrival of the first large systems, which following the visible trend of the market, will continue to arrive.

It is important to mention that the computer market made a big leap ahead in the last 4 years, and it is growing at a rate of 30 percent per year, according to the manufacturers' sales forecast.

It is expected that the use of computers in the private area will spread and become more sophisticated in the next few years following the development tendencies of the country. Already a few companies use data transmission and work towards more integrated systems.

4. THE MANUFACTURERS OF COMPUTERS

The following manufacturers are operating in Brazil: IBM, Burroughs, UNIVAC, Honeywell-Bull, NCR, Siemens, AEG-Telefunken, CII, Hewlett-Packard, DEC, and Phillips. The main activity is marketing their imported products. As support activities, they provide software and hardware maintenance, systems analysis, programming, personnel training, and activities in the service bureaux area.

IBM and Burroughs have the largest share of the market both in number and in value of computers. The approximate percentage of the manufacturers' participation in the market is the following:

<u>MANUFACTURERS</u>	<u>PERCENT OF TOTAL NUMBER</u>	<u>PERCENT OF TOTAL VALUE</u>
IBM	64.5	74
Burroughs	19.5	14
UNIVAC	11	8
Honeywell-Bull	2.5	2
NCR	1.5	1.5
Others	1	0.5

According to the last surveys, the total number of installed computers, distributed as in the above table, is about 630 (December, 1971).

Honeywell, CII, Hewlett-Packard, and DEC have only recently entered the market. Honeywell's percentage is due to the previously installed BULL-GE equipment.

Besides selling its imported products, IBM manufactures keypunches and verifiers, typewriters, and will begin in 1973 to manufacture the IBM/370-145. IBM of Brazil is the foremost exporter of manufactured products in Brazil, the sixth in marketing the products of IBM World Trade, and the fourth in education and research. Burroughs manufactures desk calculators, accounting machines, ferrite memories, and read/write heads for magnetic discs; Siemens manufactures ferrite memories. Most manufactured products are produced for exporting to subsidiaries.

The area of peripherals has an expanding market. BASF of Germany is selling magnetic tapes, discs, and their respective control units compatible with some of the IBM models. Com-Micromation is marketing off- and on-line equipments with microfilm processes. Kodak is also beginning to enter this market.

Various companies are offering data input devices: Olivetti, Mohawk, Honeywell-Bull, Friden, Facit, Hewlett-Packard. Their interests lie mainly in selling substitutes for punched cards.

5. ASSOCIATIONS IN THE AREA OF COMPUTATION

The first Brazilian Association--Associação Brasileira de Computadores Eletrônicos (ABRACE)--was founded in April, 1961, during the first Simpósio Brasileiro de Computadores Eletrônicos, sponsored by the manufacturers, shortly after the first computer was installed. Its pur-

pose was to bring together all institutions and individuals involved in computation so as to promote activities related to electronic computers. It is supported by its institutional members, everyone of which has a representative in the board of directors. The individual members also elect one member of each institutional representative in the board. At present, ABRACE has about 1,500 associates, 5 of which are institutional members: IBM, Burroughs, UNIVAC, and Olivetti.

Among its activities one should mention the second Sim^osio Brasileiro de Computadores Eletr^onicos held in S^o Paulo in 1964. Courses in programming and systems analysis are offered regularly. ABRACE has been the Brazilian representative in IFIP.

Another Brazilian association--Sociedade dos Usu^orios de Computadores Eletr^onicos e Equipmentos Subordinados (SUCESU)--was founded in September, 1965. A group of businessmen jointly decided to study the possibility of founding a society to assist in understanding and solving the common problems in data processing. SUCESU is the result of this meeting.

At present, it has about 400 institutional members from a broad variety of fields: service bureaux, banks, insurance companies, commerce, industries, computer manufacturers, forms manufacturers, schools, universities, government agencies, and consulting firms. The creation of individual memberships is being considered.

In June, 1969, the nationwide SUCESU was founded with broader objectives and international connections. As a consequence, state divisions of SUCESU were founded in S^o Paulo, Minas Gerais, Rio Grande do

Sul, Parana, Pernambuco, Bahia, and Brasilia. Among SUCESU's most successful initiatives has been the promotion of a yearly conference since 1968. Without doubt these conferences have been the most outstanding event for the Brazilian computer community, with about 2,000 participants in the latest one, in 1971. The fifth such conference will be held in October, 1972, in Rio de Janeiro.

SUCESU has a number of other activities for its associates, such as salary studies, seminars, technical publications, and study groups in various subjects. Lately, it has been working towards the creation of a certification for programmers so as to raise educational quality of the several emerging schools for programmers.

The two other associations of computer technicians are still not very influential.

6. CONCLUSIONS

The area of computation in Brazil has been a relevant one since 1967. This phenomenon was an inevitable consequence of the specially intense general growth of the Brazilian economy since that year.

Even in this fairly short time the impact of the new technology was enormous on all areas of activities in the country. So far there is no indication of unemployment provoked by the introduction of the new technology. On the contrary, it seems to have induced a multiplier effect in several domains, reorganizing traditional activities into several subareas spanned in the computerized environment. The supply of work for specialists in computation is and will continue to be very

large in the next few years, and very high salaries are offered to poorly qualified personnel. Such deficiencies and inadequacies in manpower are naturally reflected in the poor utilization of several computer installations, creating an urgent need for large-scale training and retraining programs.

As the Brazilian economy is currently expanding rapidly, the business volume of the manufacturers is accordingly very high, to the point of requiring measures such as the creation of CAPRE. The appeal of the excellent market caused exploratory activities towards manufacturing national hardware.

This last fact (national hardware) and its related problems contrasts with the previous reference to the small number and low level of the specialists at hand. Even hoping optimistically that large training programs will follow the rapid growth of the installed computing capacity, one should bear in mind the problems and limitations thereof.

These facts explain the initially mentioned insistence on sound educational programs (as opposed to training programs), and on a solid research infrastructure in the computer science area to strike an adequate balance between short-range and long-range development objectives for this new field in Brazil.

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ANNEX B

ASSOCIATION FOR COMPUTING MACHINERY

~
SÃO PAULO CHAPTER NEWSLETTER*

COMPUTING IN BRAZIL 1972

JULY 1972

*Prospective

COMPUTING IN BRAZIL 1972

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INTRODUCTION

This is the second Newsletter of the São Paulo Chapter (prospective) of the ACM. This particular issue is being published in English since it is intended for the ACM Council (who will be passing our petition in August) and also for the participants of the Rio Symposium on Computer Education for Developing Countries, where it is distributed with our compliments.

The article "Computing in Brazil - 1972" is an attempt to give an overview of computing in Brazil in July 1972. Naturally any such undertaking is subject to errors, since it is difficult to be aware of all events. Furthermore, the situation in Brazil is far from static: the annual growth rate of installed computing systems was close to 30% last year.

The information contained herein, as far as we know, is not "company confidential", but available to the public. In items 1.2 and 2, we wish to acknowledge the co-operation of Mr. Edes Landim, President of Systems S.A. of São Paulo and President of INTERCOMP, a multinational union of five companies, who kindly provided the information. For item 1.3., the examples selected and the order in which they are presented do not have any particular meaning except the attempt to present a cross-section of industries and some examples within each industry to give an idea of scale.

We hope to have comments from the readers on any omissions or errors we have made. The "letter to the editor" column is open for discussions on this topic. In future issues of the Newsletter, we hope to print any comments we shall receive.

This report was prepared with the collaboration of other members of the São Paulo Executive Council and of Mr. Edes Landim. Many people assisted us with suggestions and constructive criticism. We are extremely grateful for their valuable assistance.

We very much appreciated the financial support from Systems S. A. which made the publication of this Newsletter possible.

The São Paulo Chapter Executive Council undertakes full responsibility for the substance of the report.

Lucio Goelzer
Chairman - São Paulo Chapter

1. MARKET

1.1. Manufacturers:

In Brazil there are eleven manufacturers dealing with computer sales and renting, as follows:

IBM
Burroughs
UNIVAC (presently only selling computers)
Honeywell Bull
NCR
ESC (Siemens)
AEG - Telefunken
CII
Hewlett - Packard
DEC
Phillips

1.2. Systems Installed:

Concerning installed systems and market distribution, the situation is as follows:

Total installed (May 1972) : 750 computers

Approximate distribution by type of equipment:

TYPE	MARKET %
2nd. generation	20
3rd. generation-small size (1)	40
3rd. generation-medium size (2)	35
3rd. generation-large size (3)	5

(1) IBM/3; 360-20; 1130; G-50; Century 100; etc.

(2) IBM-360-25/30/40; B-2500/3500; U-9300/9400; etc.

(3) IBM/360-50/65; 370-145/155/165; B-6700; etc.

Approximate distribution by manufacturer:

MANUFACTURER	MARKET %	
	Number	Value
IBM	65.3	74
Burroughs	15.5	14
UNIVAC	9.4	8
Honeywell Bull	7.4	2
NCR	1.8	1.5
Others (including ESC)	0.6	0.5

Reference 8.1.

Approximate distribution by field of activity:

ACTIVITY	MARKET % (number)
Industry	35
Government and Public Services	25
Finances	23
Commerce	17

The market has been increasing by 25 to 30% per year.

1.3. Examples of Systems Installed by Industry:

1.3.1. Government

a. Federal:

- SERPRO: The Brazilian Government has established a federal data processing service, SERPRO, ("Serviço Federal de Processamento de Dados"), to provide data processing services to the federal agencies. The income tax control is one of the major tasks of SERPRO.

SERPRO has today the largest data processing facilities in Latin America, with more than 20 computer installed in centers located in major Brazilian cities. Its 1972 budget amounts to 35 million dollars.

Presently SERPRO personnel includes around 200 systems engineers and more than 2,000 specialized people.

The installed equipment includes several IBM 360/20-30, one IBM 360/65 and two IBM 370/145.

- IBI : The "Instituto Brasileiro de Informática" (IBI) was founded in 1971. The Institute belongs to the Brazilian Institute of Geography and Statistics of the Ministry of Planning. Among its projects are the processing of the demographic and economic census and the elaboration of a large data base of socio-economic data. IBI has an IBM 370/155.

- CAPRE: The Ministry of Planning has estimated that the data processing expenditures of the public administration will be around 125 million dollars from 1972 to 1974.

Considering the importance of this area, the Federal Government created a coordination committee for data processing activities (CAPRE "Comissão de Coordenação de Atividades de Processamento Eletrônico"), in April 1972. CAPRE's main purposes are to rationalize the governmental data processing investments and to upgrade the productivity of its data processing equipment.

b. State:

- PRODESP ("Companhia de Processamento de Dados do Estado de São Paulo") is an example of a state government installation. PRODESP has one IBM 360/65 installed and around 70 systems engineers.

- Another example is the State of Rio Grande do Sul, which is now investing approximately 3.5 million dollars to expand its data processing equipment (one B-6700 and one B-4700).

c. Municipal:

- PRODAM ("Companhia de Processamento de Dados do Município de São Paulo") is an example of a data processing center which will provide services to all municipal agencies. PRODAM has, on order, one IBM 370/155 with 1.6 billion bytes of direct access storage.

1.3.2. Universities

a. Rio Datacentro PUC/RJ:

The Rio Datacentro of Pontifícia Universidade Católica do Rio de Janeiro, established in 1967 as a joint initiative of PUC/RJ and IBM Brazil, is the major university computer center in Latin America. In July 1972 the systems

installed are: one IBM 1130 (since 1966), one IBM 7044/1401 (since 1967) and one IBM 370/165 (since 1972). PUC/RJ has also one Burroughs B-500, which does not belong to the Rio Datacentro, and several minis.

b. Universidade Federal do Rio de Janeiro (UFRJ):

The Núcleo de Computação Eletrônica (NCE) is the computing center of the UFRJ.

The NCE has one System IBM 1130 and one System IBM 360/40 with several terminals.

c. Universidade de São Paulo (USP):

USP does not have yet a central computing center with resources to meet the demands of all its schools and institutes. USP has several systems but they are scattered around.

In its main campus, USP has the following systems:

IBM 360/44	-	Instituto de Física
Honeywell DDP	-	Instituto de Física
515	-	
Burroughs B-3500-		Centro de Cálculo Eletrônico (this machine is available only 8 hours daily)
IBM 1130	-	Escola Politécnica
HP 2116-B	-	Escola Politécnica
IBM 1620	-	Escola Politécnica
IBM 1130	-	Instituto de Pesquisas Econômicas

The Escola de Engenharia de São Carlos and the Escola de Agricultura de Piracicaba have each an IBM 1130.

d. Universidade Federal do Rio Grande do Sul (UFRGS):

UFRGS has just installed a large scale system, the Burroughs B-6700. The University also has an IBM 1130, an HP 2114 and an HP 2100.

1.3.3. Research Centers

a. Instituto de Energia Atômica:

The Instituto de Energia Atômica (IEA) of São Paulo will install an IBM 370/155 during the second semester of 1972. IEA already has one IBM 1620.

b. Instituto Nacional de Pesquisas Espaciais:

The Instituto Nacional de Pesquisas Espaciais (INPE), located in São José dos Campos, São Paulo, has a Burroughs B-6700.

c. Centro Brasileiro de Pesquisas Físicas:

The Centro Brasileiro de Pesquisas Físicas, located in Rio de Janeiro, has one IBM 1620 and one IBM 370-145.

1.3.4. Public Utilities:

a. LIGHT (power distribution): 2 IBM 360-30, 1 IBM 340-40, 1 IBM 370/155;

b. CTB (telephone): 2 IBM 370/155.

1.3.5. Finance

a. BRADESCO:

BRADESCO ("Banco Brasileiro de Descontos") - São Paulo, has one of the largest computer installation centers in Latin America: one IBM 360/65 MP, two IBM 370/155 (on order), one IBM 370/145, four IBM 360/40, one IBM 1460, two IBM 1401, one IBM 1130, one IBM/3 and 120 terminals IBM 2260 for data entry.

b. Bolsa de Valores do Rio de Janeiro:

The Bolsa de Valores (stock exchange) of Rio de Janeiro has in operation a System/370-145 with several display terminals IBM 2260. A new project is being started for the installation of 600 display terminals and 200 printing terminals, in order to make its information readily available to all interested parties.

1.3.6. Manufacturing:

a. Volkswagen:

The Volkswagen plant in São Paulo has the following system: one IBM 360-65, two IBM 360-40, one IBM 370-165 (on order) and two IBM/3.

b. General Motors:

GM has in São Paulo one IBM 360-50, one IBM 360-30 and one IBM 370-155 (on order).

1.3.7. Data Service bureaus

a. IBM:

one 1360-65
eleven 1360-40
two 1360-25
six 1360-20
one 1130
two 1401

b. Burroughs:

two B-3500
two B-500
two B-300

c. Datamec:

five B-3500
two B-500
one B-200
one IBM 1360-25

d. Systems:

one IBM/370-145

2. MANPOWER

2.1. Existing Resources

Taking into account the equipment installed in Brazil, as well as an estimate of 20% for users with no equipment, we calculate that manpower distribution in Brazil is as follows:

Systems Analysts:	3,500
Programmers:	4,000
Computer Operators:	3,700

According to our estimates the above figures must be close to reality, within a 10% margin of error, since a survey held by SUCESU-São Paulo in mid-1971 demonstrated that there are approximately 3.9 analysts, 4.5 programmers and 4.1 operators per computer installation.

Such figures have been increasing by 25 to 30% per year: they should also represent the future annual demand.

2.2. Salary Ranges

Trying to establish monthly salary scales in Brazil is a very difficult task, since a national survey on salaries has never been held.

However, the analysis of a survey held in São Paulo, in March 1972, presents the following results:

a. Programmer (RPG, Cobol, Assembler, etc.)

	<u>Cr\$</u>	<u>US\$</u>
Minimum average salary :	1,400.00	234.00
Average average salary :	2,800.00	467.00
Maximum average salary :	4,100.00	684.00

b. Systems Analyst:

	<u>Cr\$</u>	<u>US\$</u>
Minimum average salary:	2,350.00	392.00
Average average salary :	4,250.00	708.00
Maximum average salary:	5,550.00	925.00

It should be noted that the above survey was based on types of equipment ; therefore, the minimum, average and maximum figures given were calculated according to their average values, not only as concerns equipment, but also as concerns minimum, average and maximum values of the functions referred to. In converting these figures to annual salaries, please note Brazilian law provides for a 13th month salary in December.

3. EDUCATION

3.1. Computing Education at Universities

3.1.1. Ph. D. Program in Computer Science

The Departamento de Informática of the Pontifícia Universidade Católica of Rio de Janeiro (PUC/RJ) is now starting a Ph.D. program in computer science.

The first students attending this program will graduate by 1974. It is estimated that the program will be originating 15 Ph. D.s. per year by 1978.

3.1.2. M.Sc. Programs in Computer Science

a. PUC/RJ:

Since 1967, the Departamento de Informática of PUC/RJ has been offering an active M.Sc. program in computer science.

At present, there are around 90 students participating in different stages of this program. At the end of 1971, about 25 master degrees were granted. The program is estimated to originate 30 M.Sc. per year, once it has reached a stable position.

The present faculty is composed of 26 members (4 in leave of absence in doctoral programs, 10 of which have Ph.D. degrees).

The Departamento de Informática has access to the Computing Center of PUC/RJ (Rio Datacentro, described in item 1.3.2. a.) with its IBM/370-165, IBM 7044 and IBM 1130. The staff of the Rio Datacentro, around 120 people, of which more than 50% have graduate degrees, works part-time for the Departamento de Informática.

b. Universidade de São Paulo:

The Universidade de São Paulo (USP) is planning a M.Sc. program in Computer Science to be offered by the Department of Applied Mathematics in 1973. By then this department will have 8 Ph.D.'s and 6 M.Sc.'s.

Presently the students interested in Computer Science have to take their M.Sc. either in Mathematics or in Electrical Engineering. A number of regular graduate courses in Computer Science has been offered since 1968.

c. Universidade Federal do Rio de Janeiro:

The Coordenação de Programas de Pós-graduação em Engenharia of the Universidade Federal do Rio de Janeiro (COPPE/UFRJ) offers a M. Sc. degree in Systems Engineering with great emphasis on Computer Science. The program now has 65 graduate students, half of which is on a full-time basis. There are 6 Ph.D.'s and 12 M.Sc. 's working in the Systems Engineering program. By the end of 1973, the program will be involving about 32 full-time faculty members.

The computer facilities available are described in item 1.3.2. b.

d. Universidade Estadual de Campinas:

The Instituto de Matemática, Estatística e Ciências da Com-

putação of the Universidade Estadual de Campinas is offering a M.Sc. program in Computer Science (initiated in 1971).

At present, there are around 10 students participating at different stages of this program.

3.1.3. B.Sc. Programs in Computer Science

a. Universidade Estadual de Campinas:

The Instituto de Matemática, Estatísticas e Ciências da Computação of the Universidade Estadual de Campinas started a B.Sc. program in computer science in 1969. The first group graduated in 1971.

b. Universidade de São Paulo (USP):

The Department of Applied Mathematics of USP has a program leading to a B.Sc. in Computer Science which is presently in its 2nd year. The first class (30 students) will graduate in 1974.

3.1.4. Computer Related Programs

a. Universidade de São Paulo (USP):

The Departamento de Engenharia de Eletricidade of USP offers a B.Sc. in Electrical Engineering with an option in computer engineering. The first class (about 30 students) will graduate in 1973. This program follows the COSINE curriculum.

b. Instituto Nacional de Pesquisas Espaciais (INPE):

The INPE (National Institute of Space Research) offers a M.Sc. program in Systems Analysis in São José dos Campos, São Paulo.

There are three options: economic planning, building of mathematical models and optimization.

c. Universidade Federal da Paraíba:

The Escola de Engenharia of the Universidade Federal da Paraíba, in Campina Grande, will offer a M.Sc. program in Systems Engineering, starting August 1972.

3.1.5. Basic Training

Every major Brazilian university offers some introductory under-

graduate course in Computer Programming. In some universities, this course is part of the basic subjects offered to the whole system of schools and institutes. Such is the case, for instance, of the University of São Paulo, whose course "Introduction to Computer Science" was taken by 1100 students in the first semester of 1972. This number is expected to increase to 2000 students for the first semester of 1973, involving all under-graduates from the Sciences and Engineering areas, plus an increasing number from Humanities, Economics, Business Administration, etc. The academic reforms introduced in Brazilian universities by the Federal Government has helped unify this basic course.

3.1.6. Extension Courses

Several Brazilian universities are helping to meet the country's growing needs in the area of EDP training.

Some examples are:

a. PUC/RJ:

PUC/RJ offers a program for the training of programmers and systems engineers trainees. The program is developed in three quarters. The level achieved in each trimester is:

- first trimester - Introduction to Computing (144 hours)
- second trimester - Programmer (264 hours)
- third trimester - Systems Engineer Trainee (456 hours)

b. Instituto Tecnológico de Aeronáutica (ITA):

ITA, in São José dos Campos (São Paulo), is starting a program for training programmers. The course will be developed in 6 quarters.

c. Fundação Armando Alves Penteado (FAAP):

FAAP, in São Paulo, is offering a three quarters course similar to the one given by PUC/RJ.

d. Universidade Mackenzie:

The Universidade Mackenzie, in São Paulo, is now offering a program (3 years long) for the formation of data processing personnel. The program has three levels which correspond roughly to operators, programmers and systems engineers trainees:

3.1.7. Computer Facilities at Universities

<u>INSTITUTIONS</u>	<u>EQUIPMENT</u>
1. Escola de Engenharia Industrial (RGS)	IBM 1130
2. Escola de Engenharia de São Carlos	IBM 1130
3. Escola Naval	IBM 1130
4. Faculdade de Engenharia e Agronomia de Franca	IBM 360-20
5. Faculdade de Engenharia Industrial (PUC/SP)	B-500
6. Fundação Educacional de Bauru	IBM 1130
7. Fundação Getúlio Vargas	IBM 1130
8. Instituto Mauá de Tecnologia (São Paulo)	IBM 1130
9. Instituto Militar de Engenharia	IBM 1130
10. Instituto Técnico de Alagoas	B-500.
11. Instituto Tecnológico de Aeronáutica	IBM 1130 - IBM 1620
12. Pontifícia Universidade Católica do Rio Grande do Sul	IBM 1130
13. Pontifícia Universidade Católica do Rio de Janeiro	B-500, IBM 1130, IBM 7044, IBM 1401, IBM 370-165, minis
14. Universidade de Campinas	IBM 1130, IBM 360-30
15. Universidade do Estado da Guanabara	IBM 1130
16. Universidade Federal da Bahia	B-500, IBM 1130
17. Universidade Federal de Brasília	IBM 1130
18. Universidade Federal do Ceará	IBM 1130
19. Universidade Federal do Espírito Santo	IBM 1130
20. Universidade Federal de Goiás	IBM 1130
21. Universidade Federal de Juíz de Fora	IBM 1130
22. Universidade Federal do Maranhão	IBM 1130, IBM 370-135
23. Universidade Federal de Minas Gerais	IBM 1130, IBM 360-40
24. Universidade Federal de Ouro Preto	IBM 1130
25. Universidade Federal do Pará	IBM 1130
26. Universidade Federal da Paraíba	IBM 1130 (two)
27. Universidade Federal do Paraná	IBM 1130

<u>INSTITUTIONS</u>	<u>EQUIPMENT</u>
28. Universidade Federal de Pernambuco	B-500, IBM 1130
29. Universidade Federal do Rio de Janeiro	IBM 360-40, IBM 1130, minis
30. Universidade Federal do Rio Grande do Sul	IBM 1130, B-6700, minis
31. Universidade Federal de Santa Catarina	IBM 1130
32. Universidade Federal de Santa Maria	IBM 1130
33. Universidade Federal de Sergipe	IBM 1130
34. Universidade Federal de Viçosa	IBM 1130
35. Universidade Federal Fluminense	IBM 1130
36. Universidade de Mato Grosso	IBM 1130
37. Universidade do Rio Grande do Norte	B-500
38. Universidade de São Paulo	B-3500, IBM 1620, three IBM 1130, IBM 360-44, minis

3.2. Computer Education by the Manufacturers

The manufacturers provide training in operations and programming.

The training in the area of systems analysis is generally considered inadequate.

4. RESEARCH AND DEVELOPMENT

4.1. Software and Computer Science

It is difficult to keep abreast of developments in software. Some are published in the Annals of the National DP Conference, others are published as monographs and reports of the universities while many go unheralded. So far, there is not a national vehicle for the publication of computer science research in Brazil.

The Conselho Nacional de Pesquisas (National Research Council) is currently providing strong support to computer science research in Brazil. This, along with the post-graduate programs being developed in Brazil, plus the return of students from master's and doctoral programs abroad, is bound to produce dividends. Already 60 M.Sc.'s in Computer Science (theory, software, and hardware) have graduated from Brazilian universities.

Examples of developments at universities:

-at the Instituto Tecnológico de Aeronáutica (ITA), in São José dos Campos a Portuguese version of BASIC was developed;

- at the Instituto de Matemática e Estatística, Universidade de São Paulo, a LISP interpreter, to run in the B-3500, was developed;

- COPPE - FORTRAN, a WATFOR like compiler for the IBM 1130, was developed at the Universidade Federal do Rio de Janeiro;

- cooperational system OS-RTX developed at the Instituto de Física, Universidade de São Paulo, to support an IBM 360-44/Honeywell DDP-516 system, using OS/360-MFT and RTX-16;

- at PUC in Rio, according to the Rio Datacentro and Informática annual report, publications for the year 1971 include 12 monographs published in English (4 of which were MS thesis and 2 papers in the annals of SUCESU) and 11 non-monograph MS thesis; "Automatic Construction of Syntax Recognizers", "PUCMAT - A Programming Module for Arithmetic Pattern-Matching" and "A Set of Programs to Test and Parse LL (K) Type Languages" are examples of some titles.

4.2. Developments in Digital System Hardware Design

Before 1968, it appears there was very little development work being done in logic design, possibly only some pioneering work with transistors at ITA. Then several hardware projects began to develop: at PUC in Rio, at SERPRO in Rio, at the Escola Politécnica (EPUSP) and the Instituto de Física (IFUSP) in São Paulo, and at the Instituto de Física of UFRGS in Porto Alegre. The early work at PUC was more connected with control systems and analog computing as the SALAMI project, but presently there is a digital project to provide memory for a display. At SERPRO, a multiplexing interface was built for a HP mini-computer, as part of their key-to-tape project.

At EPUSP several projects have been completed: a modem, an oscilloscope display interface and an ASCII terminal interface for an IBM Selectric typewriter, these projects using analog / digital circuits. An off-line plotter driven by a card reader was also done. At the Instituto de Física of USP several digital developments have occurred on a project called SADE to automate experiments on the Pelletron linear particle accelerator. The data collection system is to feed a Honeywell DDP-516 which in turn will be connected to an IBM S/360 Model 44. (It should be pointed out that this effort involved both hardware and software developments. To coordinate the IBM S/360 Model 44 and DDP-516, a "cooperational system" was designed). A S/360 I/O Interface termination was built for a paper tape device. The interface of six measurement consoles of the Pelletron to the DDP-516 was done, and some additional functions like a one-upper to memory were provided, causing modification of the CPU - main memory interface.

A Hewlett-Packard Display was provided with an ingeniously designed "home-made" light-pen attachment, and then interfaced to the DDP-516.

At the Instituto de Física, in Porto Alegre, a project connected multi-channel analysers used in experiments in nuclear physics to a Hewlett Packard mini-computer. In connection with this project, several interfaces to the HP 2114 have been built using HP's "do-it-yourself" interface cards. A Display and magnetic tape interface fall into this category. Also, a stand-alone control panel for use by the experimenter was built.

Most of the work being done concerns computer interfaces, but one project of the Laboratório de Sistemas Digitais (LSD) at EPUSP involves the construction of a micro-computer (4 K bytes of memory) which was designed in 1971 by graduate students. The design was simulated at the micro-operation level. To support this project, called "Patinho Feio" (ugly duckling), LSD is building a printed circuit facility. It was here that the first PC card with the plated-through hole was made in Brazil, and a few of the "Patinho Feio" pc cards have already been built using this technology. Other cards will use soldered wires and also wire-wrap sockets. Like the projects mentioned above, this one uses integrated circuits imported from the United States. This computer was considered operational on July 19, 1972. In the field of digital and logic circuit technology, one must mention the Laboratório de Microeletrônica at EPUSP. This laboratory is performing monolithic device and circuit research and development. About one year ago it produced Brazil's first integrated circuit, an ECL NOR gate. Recently, a MOS FET was produced.

Many other universities in Brazil are planning efforts in the hardware area, but to make the report brief, we have confined our attention to what was in a completed or nearly completed state. It is expected, due to the great deal of interest we have witnessed, that this area will experience a rapid growth in the near future.

5. MANUFACTURING

Many readers will be surprised to learn that the first computer assembled and tested in Brazil was the IBM 1401; this was about ten years ago. The IBM manufacturing plant, then in Rio de Janeiro, and since moved near Campinas (SP), assembled approximately seventy 1401's. (One of them was exported to Chile). The new IBM plant in addition to producing card punches (the latest models use digital logic and memories), is presently assembling and testing S/370 tape drives and tape control units. Toward the end of the year, IBM intends to assemble and test the CPU of

the S/370 Model 145. The Model 145, a medium-scale data processor having about 4 times the computing power of the S/360 Model 40, is a sophisticated system incorporating a writeable control (microprogram) memory.

Burroughs has a core memory plant in Veleiros, in São Paulo. At present, this plant is one of two Burrough's suppliers of core memories. The plant has a small computer which is used for testing and assists in quality control. It exercises the memory, displaying the results on an oscilloscope. Burroughs re-exports the memories as the read/write and sense electronics are done elsewhere. Burroughs also produces electronic calculators in São Paulo.

Siemens has a subsidiary, Icotron, in Gravataí, near Porto Alegre, where core memories are also built. However, the core planes are not tested here, they are shipped abroad for that.

In the products mentioned above, with the exception of the card punches, most of the components are imported.

The Brazilian Government is interested in fostering a national computer (CPU) industry. To this end, the Banco Nacional de Desenvolvimento Econômico (BNDE) created a fund (FUNTEC - 111) to coordinate the implementation of the project. The approach is to form a joint venture with a 1/3 participation each of the BNDE, a Brazilian firm with national capital, and an entity providing foreign capital and know-how. It was recently announced that the Brazilian firm selected was Equipamentos Eletrônicos Ltda., of Rio de Janeiro.

6. COMPUTING SOCIETIES

The first Brazilian computer society - ABRACE (Associação Brasileira de Computadores Eletrônicos) - was founded in Rio de Janeiro in April 1961. It has not expanded very much beyond Rio de Janeiro and is today (July 1972) considered quite inactive. ABRACE was the Brazilian IFIP representative until December 1971. Today Brazil has no official IFIP representative.

Another organization - SUCESU (Sociedade dos Usuários de Computadores e Equipamentos Subsidiários) - was founded in Rio de Janeiro, in September 1965. It is an organization for users, manufacturers and suppliers, currently with about 400 organizational members. In June 1969, SUCESU became a national organization. Regional chapters were founded in São Paulo, Minas Gerais, Rio Grande do Sul, Paraná, Pernambuco, Bahia and Brasília. Each year, SUCESU holds a "National Data Processing Convention", the most important for the Brazilian computing community. The 1971 meeting, held in São Paulo, had about 2.000 participants.

SUCESU provides opportunity for users of similar equipments to meet and exchange information. SUCESU also provides translations of relevant articles, conducts surveys on salaries, represents the users in meetings with Government officials, etc.

The role of the ACM Chapter is not in opposition to that of SUCESU. The Chapter, in providing a meeting place for people who, by virtue of their subscription to ACM publications, are interested in the analytical and disciplinary aspects of computing, does not infringe any existing organization in Brazil.

The Newsletter of SUCESU-São Paulo has already carried Chapter announcements. The São Paulo Chapter and SUCESU- São Paulo are discussing ways in which the two organizations can complement each other.

Besides ABRACE and SUCESU, there are two other organizations of computing personnel which are not yet quite representative.

7. MEETINGS/WORKSHOPS

7.1. "Congresso Nacional de Processamento de Dados"

It is the annual national meeting which is organized by SUCESU.

7.2. Latin American Computer Science Workshops

This workshop is sponsored by IBM World Trade.

The third workshop is taking place at PUC/RJ from July 24th to August 4th.

The intensive courses given at these workshops are conducted by foreign professors such as Prof. Bruce Arden, Prof. Michael Harrison, Prof. Richard Karp, Prof. J. Schwartz, etc.

7.3. Computers at Universities

This series of seminars (3 already have taken place) has the participation of almost all Brazilian universities. It is organized by the Council of Brazilian University Rectors.

7.4. The Rio Symposium on Computer Education for Developing Countries

August 6-12, 1972. Rio de Janeiro.

8. REFERENCES

8.1. An Overview of the Computing Activities in Brazil, Profs. C.J. Lucena,

D.F.Leite, O. Fadigas Torres, Report to the Office for Science and Technology, UN, June 1972.

- 8.2. Rio Datacentro e Deptº Informática - Relatório Anual; 1971.
- 8.3. Sessões Técnicas - IV Congresso Nacional de Processamento de Dados.

SÃO PAULO CHAPTER NEWS

1. CHAPTER COUNCIL

Chairman:	Lucio V.M.Goelzer, M.Sc. Consultant - Scientific Development Group, IBM; Professor - Universidade Estadual de Campinas
Vice-Chairman:	Dr. Valdemar Setzer Professor - Instituto de Matemática e Estatística - Universidade de São Paulo
Secretary:	Glen Langdon Jr., Ph. D. Professor - Departamento de Engenharia e Eletricidade - Universidade de São Paulo
Treasurer:	Tácito Pereira Nobre, M.Sc. Seguradora ITAÚ S/A.

2. CHAPTER MEETINGS

- 2.1. May 13, 1972:
"PRODESP": Its objectives, function and structure".
Gustavo Monteiro, M.Sc.
Technical Director of PRODESP, the DP organization of the State of São Paulo.
- 2.2. June 5, 1972:
"Optimization Algorithms and Their Complexity".
Prof. P. Wolfe, Ph. D.
IBM Research and Columbia University.
- 2.3. August 5, 1972 (scheduled):
"Performance Evaluation of Computing Systems".
Prof. B. Arden, Ph. D.
Professor, The University of Michigan.

2.4. September 2, 1972 (scheduled):

"SIMPL/I - An Extension of PL/I for Simulation and List Processing"

Prof. L. Goelzer, M.Sc.

IBM Scientific Development Group.

2.5. October 7, 1972 (scheduled):

"Theory of Semantics"

Prof. Valdemar Setzer

Universidade de São Paulo.

3. INCREASE IN THE ANNUAL DUES

Effective July 1st, 1972, the annual dues for ACM membership were raised to US\$ 35.00 . Student dues remained unchanged (US\$ 8.00).

4. SÃO PAULO CHAPTER ADDRESS

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