Some commentaries on the history of computer science in Argentina

Pablo Miguel Jacovkis

Departamento de Computación and Instituto de Cálculo
Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires
Ciudad Universitaria, 1428 Buenos Aires, Argentina
`jacovkis@dc.uba.ar`

Abstract. To historians and sociologists of science, computer science has very attractive characteristics. On the one hand, we all know and acknowledge the profound impact it has had in the scientific and technological development all over the world, and in the social changes that this development caused (suffice it to mention Internet or the human genome sequencing, project much more computational than biological). On the other hand, interesting enough, computer science is the only "hard" science some of whose creators were alive until not many years, and some of their main disciples are alive today. It is as if in physics and chemistry some important disciple of Newton or Lavoisier were alive, and perhaps active. In Argentina, to this situation we must add that the evolution of computer science was strongly influenced – probably more than any other exact and natural science – by its political history: being the newest of the sciences, it was the most sensitive to the events that happened between 1966 and 1983, and no "aseptic" vision, that tries to use the "most neutral" possible criteria can avoid taking into account the terrible damage that the military dictatorships caused to its incipient development. We shall try then to comment here the evolution of computer science in Argentina, its current problems, and the influence of the Argentinean political history on this evolution.

1 Introduction

Computer science is the youngest of the exact and natural sciences. As such, its history mixes with journalism and autobiography, and the aggressive discussions of the past that we observe dispassionately, like the controversy between Newton and Leibniz about the priority in the invention of calculus, are not yet so dispassionate; a good example is the book by Goldstine [10], invaluable but with a strong bias that not all people accept. The electronic "protocomputer" ENIAC (*Electronic Numerical Integrator and Computer*) began to work in December 1945, as the above mentioned book by Goldstine indicates (see also [12]), and the famous von Neumann manuscript (see [24], on which the notion of "von Neumann architecture" is based, prepared to be applied to the design of EDVAC (*Electronic Discrete Variable Automatic Computer*) to improve its efficiency with

regard to ENIAC, was written in March, 1945. This manuscript was extraordinarily useful from then on in the development of computers, and we can say that then began the "informatization" of societies where computer science advanced.

But, for reasons that Babini [4] clearly explains, Argentina entered the computer age with a considerable delay. In fact, Argentina entered the computer age after Perón's fall, in 1955, that is, one decade later. This decade of delay had also, unfortunately, political causes. The policy of maximum possible autarchy during almost all the years of the first Perón administration (1946–1955), plus his mistrust vis-à-vis the universities, which he considered essentially political enemies (and from where he fired as many opponents as he could), caused a considerable delay in many areas, and therefore a tremendous damage. It is very well known the fiasco – internationally known – caused by the Huemul atomic project, in which Perón, wrongly advised, spent a significant amount of money (see [14]). But there was also a benefit from the Huemul project: the creation of the National Agency for Atomic Energy. With regard to informatics there was only cost and no benefit. The cost – a significant cost – is due to the theoretical and commercial delay. During Perón administration, as Babini indicates in his book, the most advanced equipment consisted of tabulators based on punched cards.

2 The period 1956–1966

Only after Perón's fall, in September, 1955, we can speak about development of informatics in Argentina. On the one hand, it was easier to import foreign equipment, so that the eventual arrival of computers to Argentina was facilitated. On the other hand, some universities became influenced by a group of intellectuals that considered science and technology extremely important for any project of development in Argentina. The political climate during almost all the period 1955–66 was very curious: a grave and – during that period – not solved political crisis originated in the proscription of the Peronist Party and, consequently, a lack of legitimacy of the constitutional authorities (Presidents Arturo Frondizi, 1958–62, and Arturo Illia, 1963–66; José María Guido's Presidency, 1962–63, was in fact a military government in which Guido was a puppet, that did not changed anything), was the frame under which two groups disputed the power in the Universities (above all in the University of Buenos Aires), the "reformists" and the "humanists". Both had a "development" project, that had more points in common with Frondizi's project (whom both, but specially the reformists, hated) than what they realized. These points in common were based on an almost naïve belief in the power of science and technology, "soft" as well as "hard", as a tool for development.

Therefore, during the almost eleven years that the university was governed autonomously by reformists and humanists, a peculiar situation happened in which a large group of people in different universities, and specially in the School of Science of the University of Buenos Aires, with an unusual enthusiasm, contributed to transform the university structures so that they became modern and

democratic centers for teaching and research, under the constant menace of a governmental intervention, given that this project was considered communist by many powerful political actors, among them of course the Army.

The menace materialized one month after the coup d'état that, on June 28, 1966, overthrew President Illia and replaced him by a military dictator, General Juan Carlos Onganía: on July 29, 1966, the government revoked the autonomy of the universities. Some hours later the Police entered violently into the School of Science of the University of Buenos Aires, and savagely struck students, graduates and faculty, in a brutal incident that from then on was called "the night of the long sticks" [15]. Anyway, let us not forget that the above mentioned transformation of the university structures was partial, at most: the Dean of the School of Law of the University of Buenos Aires was appointed Justice of the Supreme Court by General Onganía.

The decade 1956–66, rightly considered the "golden decade" of the University of Buenos Aires, was witness of an impressive development in its School of Sciences, development that began in 1955 with the new Dean José Babini, during whose administration the departamental organization of the School was implemented, full–time professors were appointed and scientific research was stimulated, and continued under the adminstration of Rolando Víctor García, Dean between 1957 and 1966. The outstanding personality and leadership of García was extremely important in overcoming the permanent budgetary and burocratic difficulties of state institutions.

In 1957 the University of Buenos Aires decided to construct a new building for part of the School of Sciences in the University Campus, as part of an ambitious plan to bring the Schools – or, at least, several of them – to that campus. And here we must mention García's Deputy Dean, Manuel Sadosky.

Among all the figures that contributed to the creation and development of computer science in Argentina Manuel Sadosky clearly stands out. When the University of Buenos Aires began its reorganization after Perón's fall in 1955, Sadosky joined the School of Sciences as a Professor at the Department of Mathematics, and began to think in the development of applied mathematics. In those times, most scientists considered the computer as a device with which calculations with many numbers could be done very fast (what, of course, is true) and so as a powerful tool for helping other sciences, and particularly applied mathematics. When the new building for part of the School of Sciences began to be constructed, Sadosky posed three fundamental ideas: to obtain a computer for the School, to create an institute of applied mathematics, as an institutional "base" for using the computer, and to create a computer science degree.

The institute, named "Instituto de Cálculo", began to work in 1960, and was definitively approved by the High Council of the University of Buenos Aires in 1962, as the first institute in agreement with the new regulations of the University. Sadosky was its Director since the beginnings until the 1966 coup, and he was helped by his main collaborator, the mathematician Rebeca Guber. A detailed description of the first years of the Instituto del Cálculo may be consulted

in the interview to Sadosky [18]; a semblance of his personality may be seen in [6].

With regard to the computer, it is interesting to see the process that finished with its acquisition. Firstly, it was necessary to decide whether the computer should be bought (abroad) or should be constructed in our country. In fact, both ideas were implemented, with different results: in the School of Engineering of the University of Buenos Aires there was a project, directed by Humberto Ciancaglini, to build a computer, named CEFIBA (Electronic Computer of the School of Engineering). The computer was built between 1958 and 1962 and, in spite of the tremendously unfavorable circumstances, (see [4]), the project was useful to train the participants. CEFIBA was above all an ambitious exercise, discontinued after the 1966 coup d'état.

There was besides a similar project at the Southern National University, in Bahía Blanca, directed by Jorge Santos, that will be described below.

Simultaneously the School of Sciences decided to buy a computer. A committee was formed, whose members were Sadosky, Alberto González Domínguez and Simón Altman (Altman was the only one that had experience with computers), that prepared the international tender. There were bids from four firms, namely IBM, Remington and Philco from USA and Ferranti from UK. Once it was decided that the computer to be bought was the Mercury II from Ferranti (for which a group of scientists of the University of Manchester had created a programming language, Autocode, easy to learn and friendly for scientific applications), a grant was requested to the University of Buenos Aires and to the recently created National Council for Science, so that those institutions could pay for the purchase. The fact that Rolando García was the Vicepresident of the National Council of Science helped to convince the Board of Directors to approve, at the end of 1958, a £152,099 grant. Specifically, as García tells [9], the President of the Council, Bernardo Houssay, was opposed to the purchase (he said that he, Houssay, had won the Nobel Prize in spite of not having tools so expensive) and it was necessary that, according to García's strategy, other member of the Board, Braun Menéndez, convinced Houssay not to assist to the meeting of the Board in which the grant was assigned. All was made with incredible precision: the building where the computer would be installed was under construction, and part of it should be ready when the computer arrived, that is, in January, 1961. Meanwhile, the future analysts and programmers were trained, an engineer, the late Oscar Matiussi, was sent during one year to the University of Manchester in 1960 to acquire experience in maintaining the computer and other engineer, Jonas Paiuk, spent three months in Manchester in Ferranti's laboratories. When the computer began to be installed, Professor Cicely Popplewell came from Manchester to complete the training of the local staff. Soon programmers from several national universities (and also programmers from the Uruguayan University of the Republic, at Montevideo) and from different institutes of research were trained. From then on, and till 1966, the computer was intensely used by the groups of research of the Instituto de Cálculo (in mathematical economy, operations research, statistics, applied mechanics, numerical

analysis, programming systems and computational linguistics, groups directed respectively by Oscar Varsavsky, Julián Aráoz, Sigfrido Mazza, Mario Gradowczyk, Pedro Zadunaisky, Wilfredo Durán and Eugenia Fisher), by other groups of researchers of the School of Sciences and other universities and scientific institutes and by external users to which fees were charged, thanks to which researches and graduate students could be funded. It is interesting to remark that from the seven groups of research mentioned before, only two (programming systems and computational linguistics) may be considered as belonging to the "hard core" of computing; the other groups belong either to the applied mathematics area or are at the boundary between applied mathematics and computer science. This is rather logical, given that computer science, as an autonomous discipline, was at the beginnings: for many people, computers were essentially a powerful tool to facilitate numerical computations. The concept of "powerful tool" has evolved: Ferranti Mercury II had a memory of 1024 40-bits words, an auxiliary memory initially composed of 16,384 words, data input through punched paper tape, and data output through punched paper tape and teletype; later on, Paiuk constructed a converter from punched cards to punched paper tape, and a facility was connected to graph curves ([4] describes carefully the technical characteristics of this computer and others that were installed in those years). The computer needed also a large room specially prepared and air-conditioned. The personal computer in which I am writing now (that is not a particularly modern one) occupies the room of a desk, has a 512 MB RAM-memory, a 37.2 GB rigid disk, a 650 MB compact disc, and its data are inputted by keyboard, by compact disc, or by a modest 1.44 MB floppy disc. Of course a short visit to the web pages of manufacturers – and above all to the web pages of manufacturers of supercomputers – gives us a much more impressive image of the technological advance, without taking into account innumerable options of current computers that the Mercury had not.

It is interesting to follow the history of some of the former members of the Instituto de Cálculo after their resignations as a consequence of the assault against the universities. Oscar Varsavsky (who, in fact, did not resign after this attack, but some months before, to go to Caracas to work at the Central University of Venezuela and at the Center for Development Studies, CENDES) continued, on the one hand, his ambitious project of mathematical modelling in social sciences, for which he affirmed that he needed a type of mathematics different from the type of mathematics used as a language for natural sciences, but that used the computer as a basic tool. On these subjects, he had began to work at the Instituto de Cálculo, see [7], [17], [20]. In 1970 he returned to Argentina after having implemented a series of mathematical models (demographic, educational and economic) in CENDES, that required an intensive use of computing, and his activity had a more and more political bias until his passing away in 1976. He considered that scientists should be qualified professionals involved in a "liberating" political project and, with his openness, perceptiveness and confronting style – that he maintained during all his life – spent a lot of time popularizing this standpoint writing a series of books, to me very arguable, but plenty of

interesting ideas. We can specially mention [21] and [22]. I collaborated in those times with him and, although I disagree both with his political conception and with his proposal of an applied mathematics different from the orthodox one (subjects that deserve a separate analysis), I think that his idea of a national project continues to hold, among other reasons for the complete lack of ideas thereabout.

Mario Gradowczyk continued his research on fluid mechanics in Montevideo, Boston (MIT) and the Argentinean National Agency for Atomic Energy until 1970, when he began his work as a private consultant in mathematical models in fluvial engineering.

Julián Aráoz settled in Venezuela, where he continued his academic career until his retirement, with an intermission when he was in Canada finishing his Ph. D. studies. Both his Ph. D. thesis and his subsequent academic activity were centered in combinatorial optimization. Aráoz collaborated generously with Argentina from the restoration of democracy in 1983 on, fundamentally as invited professor at the Department of Computer Science of the School of Science of the University of Buenos Aires and at the ESLAI (Latin American College of Informatics).

It is worth mentioning that, when they worked at the Instituto de Cálculo, Aráoz and Varsavsky directed a project on simulation of Andean rivers, after an agreement with the Argentine Federal Council of Investments (CFI) and the Economic Comission for Latin America and the Caribbean (ECLAC), that was probably the first contract in Argentina related to applied mathematics, and was similar to – but developed independently from – the Harvard Water Program, world leader in water resources planning [3]. Had the experience of the Instituto de Cálculo not been shattered, Argentina could have now an internationally known academic school in water resources planning – subject particularly important for Argentina.

Pedro Zadunaisky did not go abroad after the Night of Long Sticks: he got a position at the San Miguel Observatory and later at the National Agency of Spatial Activities (CONAE). He returned to the Department of Mathematics of the School of Sciences of the University of Buenos Aires after the 1983 restoration of democracy, and is currently professor emeritus. He continues active, working, as usual, in numerical solution of the equations of celestial mechanics.

Sigfrido Mazza emigrated to Brazil, where he was one of the founders of the Brazilian Society of Statistics. Wilfredo Durán emigrated, as many others, to Venezuela.

Besides, many young scientists worked at the Instituto de Cálculo, in the different groups, that later stood out individually. We can include among them Víctor Yohai, founder of the school of robust statistics in Argentina, currently professor emeritus at the School of Science of the University of Buenos Aires; Roberto Frenkel and Arturo O'Connell, distinguished economists (O'Connell is currently member of the board of the Argentine Federal Reserve Bank – Banco Central – and Frenkel was member of the board of the Bank of the Province of Buenos Aires); Alberto Minujin, specialized in sampling in underdeveloped

countries; the late Jorge Sabato, sociologist and former Minister of Education of Argentina during the Alfonsín administration; and Hugo Folguera, that created the group of research in applied mathematics at FATE Neumáticos, first group of research in a private firm in Argentina, group that, after the untimely death of Folguera in 1979, could not survive the economic policies of the Videla's dictatorship.

The third foundational project on computing in Argentina, also carried on by Sadosky, was the creation of the computer science degree, presented to the Directive Council of the School of Sciences in 1962, and approved definitively by the High Council of the University in 1963. The computer science program – the first offered in the country – was shorter than the other traditional "licenciado" programs (that were five years long); its objective was to educate "scientists assistants": programmers, analysts, etc., that could get integrated into the scientific community. Besides, the computer science degree would be useful in the sense that the large public and private companies – that already had began to install computer equipment for administrative purposes – could hire personnel not necessarily trained by them, with all the flaws that this procedure has. Upon this idea similar computer science programs were created in other universities as, for instance, the National University of La Plata's program. A detailed analysis of the different computer science curricula at the School of Science of the University of Buenos Aires may be consulted in [8].

The previous paragraphs may induce the reader to think that computer science was developing only in Buenos Aires; this is not true, as can be checked describing the already mentioned Jorge Santos project in Bahía Blanca [19]. At the end of 1956, before the brand-new Southern National University was one year old, Santos organized the Seminar on Computing with senior students of the electrical engineering program, germ of the current Laboratory of Digital Systems of the Department of Electrical Engineering and Computers. When Santos returned from a sojourn in Manchester, UK, between 1959 and 1960 (with a fellowship from the National Council of Science to study logical design of computers) his group began to work in the development of a small computer and to research in multivariate algebras and their electronic implementation. The construction of the computer was suspended when, after President Frondizi was overthrown by the usual military coup d'état in 1962, the grant on which it depended, awarded by the Province of Buenos Aires, was interrupted (in 1976 the former main participants in this group were fired from the University by the military dictatorship, so that the group disappeared until, in 1987, Santos returned to the University and recreated the group, that is currently active).

In the mid-nineteen sixties the activity in computer science, both professional and academic, was rapidly developing in Argentina, with a growth characterized by the enthusiasm of people involved, both professionals with other backgrounds, young students, brand-new graduates and even practitioners without degrees, when President Illia was overthrown by General Onganía coup d'état, followed by the revocation of the autonomy of the universities. Although the damage that this attack on the universities caused to Argentinean higher education and

science is perfectly known (for instance, in the University of Buenos Aires more than 1,300 faculty, graduate students and teaching assistants resigned), it is not necessarily known by the general public how this policy was a catastrophe for computer science, because it completely destroyed the academic development of the new science in a crucial moment of its development in the world: as an example, let us mention that *all* the members of the Instituto de Cálculo resigned.

That was the time in which computer science began to have significance as autonomous science and technology (let us remember that 1968 was the year of the first curriculum of the Association for Computing Machinery) and all that period was lost in our country. In particular, it is worth mentioning that at the School of Science of the University of Buenos Aires the computer, whose replacement was already under study before the military coup, simply disappeared and the degree was offered during fifteen years without computational facilities. The creation of the "licenciatura" five-years-long degree had to wait until 1982. The students had to use the IBM 360 computer installed at the University Hospital, or the computer installed at the School of Engineering, where a system analysis degree was created at the beginning of the nineteen seventies on the personal initiative of Emilio Jáuregui.

In short, the balance of the 1966 military coup d'état, regarding informatics, is that it caused the almost total paralysis in research matters, and an abrupt fall in the quality of teaching. The seriousness of this fact and the responsibility of the military and their collaborators increase when we remark that not only informatics is, together with biology, the area of knowledge that developed most in the second half of the twentieth century, but also that, due to its characteristics, its development in Argentina would have permitted the creation of a high-technology software industry like India's, Israel's and Ireland's.

3   The period 1966–1983

During the long period of military dictatorships between 1966 and 1983 – only interrupted between 1973 and 1976 by eventful Peronist administrations – university computer sciences developed more in the interior of the country than in Buenos Aires. In Buenos Aires a refreshing air could be breathed in 1972, when Esteban Di Tada was in charge of the course on programming and updated completely its curriculum, and, above all, in 1973–74, during the brief "national and popular University". In that period a "licenciado" degree was proposed [8] but, after the extremely left-wing-oriented University was replaced in 1974 by the most extremely right-wing-oriented one since 1943 the project was cut short and computer science in Buenos Aires had practically neither significant changes nor modernizations until the democratic restoration in 1983.

On the contrary, better winds blew in the interior. In those times many new universities were founded in different cities of Argentina, and in several of them new computer science degrees were offered. Some of these programs had a much more modern and updated bias than Buenos Aires's, for instance the degree offered by the National University of the Center of Buenos Aires Province at

Tandil and by the National University of San Luis at San Luis. This greater development in those universities was due, to a certain extent, to the fact that in the University of Buenos Aires the curricula were managed by employees of large informatics firms, interested above all in guaranteeing that the curricula trained the students in the use of their products while, luckily, these firms were not particularly interested in the students of the interior.

In the development of modern university curricula in Tandil and, above all, in San Luis, it is worth mentioning (the list is not exhaustive) the leading role played by Hugo Rickeboer, Armando Haeberer (untimely deceased in 2003), Jorge Aguirre, Jorge Boria, Raúl Gallard in San Luis (tragically deceased in 2004) and Ángel Orbe in Tandil. The prestige that these degrees have today is closely related to the participation of these people in their origins. A description of the activities in Tandil and San Luis of Haeberer and some other people above-mentioned may be seen in [13]. But none of these remarkable efforts was integrated in a national policy for informatics, in a time when almost all countries had one.

In those years, besides, important technological changes took place in informatics that affected the society and, in this case, their influence was immediately felt in Argentina. Contrary to the situation at the beginning of computer science in the nineteen forties, when there was in Argentina a project of autarchic development, with a certain isolation respect of the world and difficulties for importing goods, from the 1976 military coup d'état on a policy of protection of national industries was abandoned and, with regard to informatics, this policy permitted that technological novelties from the First World arrived very soon to Argentina.

Those technological changes consisted, essentially, in the gradual replacement of the mainframes by minicomputers. The I-O interface to mainframes for non privileged users was rather slow: they had to bring the input data (stored in punched cards, discs or magnetic tapes) to the computer center and, if they were lucky, they could aspire to at most two or three runs a day. Minicomputers, on the other hand, permitted always interactive operations: many terminals worked simultaneously, and a user could input the data from his or her terminal – and also see the results. This caused a decrease of the formidable power that the heads of the computer centers had: the speed with which an user could get the results from his or her run became sufficiently independent from the will of the head of the computer center. That was an important step in the "democratization" of the use of computers, that was a kind of preface to the great change of the nineteen eighties: the personal computer.

As a final commentary on that era, it is worth mentioning that the Electronic Division of the firm FATE was in charge, from the beginning of the nineteen seventies on, of a project to build a minicomputer. The project was led by Alberto Bilotti, and was eventually discontinued in 1979 [4]. It is very interesting to discuss whether the failure of this project was due to the "anti-protectionist" policy adopted by the military dictatorship or to a completely wrong approach regard-

ing the feasibility of this kind of project for a country with the characteristics of Argentina.

4 Computer science from the restoration of democracy on

It was necessary to wait until the restoration of democracy in 1983 for a consistent policy to be adopted by the government. Again the figure of Manuel Sadosky appeared, now as Secretary of State for Science and Technology; the Secretariat included an Under-Secretariat for Informatics.

As Secretary Sadosky – with the active collaboration of Rebeca Guber as Under-Secretary for Operational Coordination – motivated the creation of the Latin American College of Informatics (ESLAI), conceived as a very high-quality university institute, with a three year-long curriculum, with many characteristics of the Balseiro Institute for nuclear physics and engineering, but in informatics. Each cohort should have up to twenty Argentine students and ten students from other Latin American countries, all of them awarded a scholarship so that they could study full time. All students – who should have completed two years of study of science or engineering – were admitted after a very rigorous admission exam. It is interesting to comment that ESLAI never had Chilean or Brazilian students, what shows that already when ESLAI was created in 1985 computer science was more developed in those countries than in ours.

ESLAI was financially supported by the now defunct Intergovernmental Bureau of Informatics (IBI), based in Rome, and was academically supported by several Argentine people living abroad (Mauricio Milchberg, Norma Lijtmaer and Julián Aráoz) who contributed to solidify its international image and to facilitate the sojourn of distinguished foreign scientists as invited professors.

The degree awarded by ESLAI was "licenciado" in informatics through the National University of Luján, although its actual dependence of this University was nil. It was an administrative "device" that, by the way, was useful to show how unstable are academic projects outside the university when no national policy exists. The Instituto Balseiro survived because was supported the National Agency of Atomic Energy, and is now sufficiently consolidated, while ESLAI did not had behind a powerful agency supporting it (the National Agency of Atomic Energy represented the only project thought of as a national policy in Argentina – maintained independently from governmental changes – in the last sixty years).

The Director of ESLAI during all its existence was Jorge Vidart, one of the Uruguayan young men that surrounded Sadosky when, after he resigned in 1966, he organized the degree in computer science at the University of the Republic, in Montevideo. The Deputy Director was Armando Haeberer, until he emigrated to Rio de Janeiro, and then Jorge Aguirre.

ESLAI functioned until 1990, when it was closed by the congenital flaw of having been an idea of the previous government. This is a clear example of how NOT to have a national policy in informatics (or in any other science, for that matter). Its last students got their degrees in 1991, and the rest of the

students had to return to their original universities. It is possible to assess the immense damage that the closure of ESLAI originated observing the positive effect that had the incorporation of several of its graduates to teaching and research in Argentina, the high-quality professional activity of others, and the performance of its non graduated students, that had to complete their studies in other universities. And all that with only three cohorts of graduates. Interesting opinions on ESLAI of several of its former students and professors may be seen in [1], [11], [16], [23], and in the interview to Gabriel Baum [5], all included in the special issue of the *Newsletter Electronic of SADIO*, in 2003, dedicated to the fifteen years of the graduation ceremony of the first graduates. Other data may be consulted in [2].

Besides ESLAI, during the period in which Sadosky was the Secretary for Science and Technology there was a successful joint program with Brazil, the Argentinean-Brazilian Program of Research and Advanced Studies in Computer Science (PABI) whose coordinators were Armando Haeberer, representing Argentina, and Carlos Pereira de Lucena, representing Brazil. This program proposed the creation of a joint research group from both countries, and specially the carrying out of the Argentinean-Brazilian Schools of Informatics (EBAIs), summer schools that took place annually, alternating between a city in Argentina and a city in Brazil. The participants were undergraduate and graduate students who were awarded scholarships to assist (around 250 for each country).

The EBAIs were extremely useful for the contacts between researchers, young graduates and students from both countries. As research in informatics was much more developed in Brazil than in Argentina, the benefits obtained by the Argentinean participants was considerable. Besides, the professors of the different courses had to write books on the subjects they treated, so that the updated bibliographic supply in Spanish and Portuguese increased significantly. The history of ESLAI shows clearly the relative interest of the Argentinean administrations: the four first ESLAIs took place in 1986, 1987, 1988 and 1989, during Alfonsín administration, in Campinas, Tandil, Curitiba and Río Hondo, respectively. In 1989 President Alfonsín transferred eventfully (and in advance) the government to President Menem. Immediately the new government decided that the EBAIs should take place every two years instead of annually and, after the meetings of Nova Friburgo (1991) and Embalse de Río Tercero (1993), the School was definitively discontinued. A detailed description of the PABI and the EBAIs may be consulted in [2].

But ESLAI and PABI were not the only milestones in the development of informatics in Argentina during the nineteen eighties. With the democratic restoration many professionals who had been out of the universities during the dictatorship returned to them, or accepted positions in them for the first time in their lives. The panorama was rather discouraging: there were practically no people with Ph. D. degrees in computer science in Argentina, and there was neither budget nor political decision to repatriate the few Argentineans with foreign Ph. D. degrees in computer science, or to attract foreign researchers, or to send graduate students abroad so that they finish their Ph. D. programs guarantee-

ing them academic positions in Argentina when they returned, as Brazil did. In spite of all that significant advances could be signalled: curricula in computer science and related areas were updated (at the School of Science of the University of Buenos Aires, for instance, the 1982 curriculum was changed in 1987 and then in 1993), the contacts and collaborations with Argentinean researchers based abroad were strengthened, and more and more students were trained, that enrolled in computer science programs probably influenced by the phenomenal spreading of personal computers and teleinformatics, plus the existence of many well paid industrial positions.

With the scarce available resources many important projects were successfully carried out, of which perhaps the most significant was the implantation, for the first time in Argentina, of academic networks of e-mail and Internet, thanks, on the one hand, to a work group at the School of Sciences of the University of Buenos Aires headed by the then undergraduate student Julián Dunayevich and, on the other hand, independently, to the network Retina of the Ciencia Hoy Association headed by Emma Pérez Ferreira, who had been a user of the Instituto de Cálculo in the nineteen sixties when she was a researcher at the National Agency for Atomic Energy, and who continued working in computer networks until she died in 2005.

It is worth mentioning besides that from 1987 on, on the initiative of Hugo Scolnik, then Head of the Department of Computer Science (that he contributed more than anybody to create) at the School of Science of the University of Buenos Aires, Schools of Informatics take annually place at this Department as winter schools.

In the nineteen nineties research was reinforced in several universities, the Ph. D. programs began (the first computer science Ph. D. was awarded by the University of San Luis), and the quality of curricula, of the preparation of strand-new professionals and of research improved considerably. From 1994 on, the Department of Computer Science of the School of Sciences of the University of Río Cuarto, on initiative of the Head of the Department, Jorge Aguirre, organizes the Río Schools that, essentially, work as a summer equivalent to the winter schools at Buenos Aires, and have the same positive effect.

Nonetheless, the profound problems that existed have not disappeared: there is no national policy in a scientific area crucial for Argentinean development, so that the activities of research and development depend fundamentally on the personal and institutional effort at several universities. Departments of Computer Sciences of the universities are not different from other Departments of Science: low salaries and lack of sufficient academic positions force many young people to establish abroad, after getting their Ph. D. degrees, or even before; many go abroad as graduate students and do not return. In informatics, this situation gets worse because of an – in a sense lucky – circumstance: in spite of the fall of the "informatics bubble" of the last years, to obtain a position in industry in informatics with a reasonable salary – against which a faculty salary cannot compete – continues to be relatively easy. This circumstance accelerates the exodus of potential researchers in informatics and even delays, and some-

times prevent, the graduation of students, who begin to work as undergraduate students and become distant from the university. While this situation does not change, the projects will be at the mercy of the political and economic upheavals in Argentina. The measures recently taken by the current administration lead to a cautious optimism; in the next years it will be seen whether this optimism is or is not justified.

Acknowledgments

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