CENTRIA

1999 Report of Activities
2000 Planned Activities
2000 Budget

Director: Luís Moniz Pereira
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July 2000

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1 CENTRIA 1999 report of activities

The present report was unanimously approved by the Scientific Committee of CENTRIA in July 11, 2000. The plans approved in 1998 for 1999 were successfully carried out, as can be seen by comparing the plans with the present report: an overall quite positive evolution, as measured by output. The global indicators in the tables in Section 9 show, with respect to 1998:

- A very positive 40% increase in the number of publications in a year.
- A notable 280% increase in publications with external co-authorship.
- A strong 170% increase in publications with external international co-authorship, and a 400% increase in publications with external national co-authorship.
- An increase in the number of international scientific meetings organized.
- Though the number of ongoing projects decreased by 25%, the funding in a year afforded by projects diminished just 10%. So, less projects but with greater average funding. In any case this index is highly dependent on the completion dates of projects, and on the calls for projects that took place and their dates. The latest call for national projects was out only at the end of 1999 and with results known just in July 2000.
- The number of ongoing PhD students increased by 7%, and the number of ongoing MSc students by 17%.
- The number of visitors increased 40%, from 13 to 18.
- Journal publications went up from 2 in 1998 to 7 in 1999.

Other indicators, including a more detailed examination of types of publication, and publications by each subarea, are to be found in the annexes.

The MSc in Applied Artificial Intelligence, wholly coordinated and taught by CENTRIA members, continued in 1999/2000 with an enrollment of 10 students, and new courses were offered in it. Refer to the MSc URL at: http://ssdi.di.fct.unl.pt/~ miaa/

At the end of December 1999, the 3-year term of the Director and members of the Board expired and elections were held then, according to the statutes. The Director (Luís Moniz Pereira) was re-elected for another 3-year term, and so were the Board members (Gabriel Pereira Lopes, Pedro Barahona). An additional Board member was voted in (José Júlio Alferes).

The 1999 budget was executed according to plan, including the programatic funding for equipment and library. The programatic funding for visitors was allocated, and announcements will be posted in 2000 for two visiting positions. The distribution of the running funds among the members was made on the basis of publication productivity, in number and type, according to a pre-defined set of rules we have been using, and some slight refinements were made to the rules.

The centre's Director proposed to the University the setting up of a Council of Centres of the Faculty of Science and Technology, comprised of its 14 Directors, who elect a President amongst themselves, in order to help establish and administrate university policy towards the Centres. This structure, now in place and functional, is being worded into the new Statutes. The Director of CENTRIA was elected as President.

The Advisory Committee was modified. Prof. Robert Kowalski, who retired from Imperial College, asked to be replaced. Prof. David Warren, from the State University of New York at Stony Brook, took his place. The other members continued on: Prof. Ryszard Michalski (George Mason U.), Dr Fernando Pereira (ATT, New Jersey), and Prof. Jörg Siekmann (DFKI, Saarbrucken). Of these, only Dr Fernando Pereira visited the centre in 1999, but the centre's Director had the occasion to meet and consult personally with all the other members too. Annexed to this document, we attach the views of the Advisory Committee on this 1999 report and our plans for 2000.

The detailed rendition of each of the subareas' activities is to be found below. Of the 5 areas, Cognitive Science is the one least developed and still experiencing difficulties in making a start. This is in part explained by one of its more senior members having been named pro-rector, though the commission ends in the middle of 2000. The plans for 2000 better detail how it has and will be re-enforced. An additional PhD student, expected to join us in the future, is now at the Berkeley U. Cognitive Sciences Center.

From the start of 2000, three of the PhDs in the Soft Computing area have left the Centre, for reasons extraneous to the Centre. The year 2000 plan explains the remedial actions we are taking, including the accession of new members, in that priority subarea.

A number of scientific bridges were pursued between the subareas, to reinforce the unity and cross-fertilization within the Centre. Namely, between KRR and NL, between Learning and KRR, and Learning and NL. The plans for 2000 further detail the construction of these bridges.

In all, 1999 was a very productive year, with all its subareas, except the emerging Cognitive Science, clearly gaining in momentum and in internationalization.

1.1 Subarea: Knowledge Representation and Reasoning, and Logic Programming

CENTRIA's "Knowledge Representation and Reasoning, and Logic Programming" area focused its activities in 1999 on the following main topics: updates of logic programs and its use for modeling problems of reasoning about action, transaction logic, generalized annotated logic programs and its relationships with Fuzzy Logic, distributed tabling and revision systems for paraconsistent extended logic programs, learning with inductive logic programs, dealing with paraconsistency, and the use of logic programs to model rational agents. Additionally, implementation and applications were carried out. Work on the application of the developments in this area to the construction of rational agents was also vigorously pursued in 1999, in the context of PRAXIS project MENTAL.

Dissemination of results continued to be an important concern. In this respect, 19 papers were published in this subarea in 1999: 4 in journals, 1 as a book chapter, 6 in proceedings cited by the SCI, 8 in other proceedings. Of all publications 63% comprised international cooperation authorship, 11% national cooperation authorship, and 26% were internal to CENTRIA.

A new book, on "Paraconsistency and Constraints in Logic Programming" was accepted by Kluwer for publication, planned for 2000.

Two members delivered an advanced course in the "11th European Summer School in Logic, Language and Information", August 1999, Utrecht, based on our research developed in this area, and titled "Reasoning with Logic Programming". The course slides are available online.

The collaboration continued with the State University of California at Riverside, the State University of New York at Stone Brook, the University of Uppsala, City University London, and jointly with the Universities of Bologna and Ferrara. It focused on the issues of: updating (Riverside), tabling abduction, annotated programs, and psychiatric diagnosis (Stony Brook), rational agents (Uppsala), diagnosis (City University),and inductive learning (Bologna and Ferrara). A significant number of co-authored papers with researchers from these Universities were prepared and appeared in 1999.

Collaboration with CITI, another centre at our department, took place on the implementation of distributed tabling systems in high-speed networks. This is the subject of project TARDE, coordinated by us, accepted by PRAXIS in 1999, and begun in September. The development of this line of research is also supported by the programatic funding granted for a cluster of fast networked machines.

PRAXIS project ACROPOLE was completed, and its final report is available.

In September 1999, the PRAXIS OAR project (Object-oriented And-or tree Rewriting systems) was started which aims at defining a computational model and providing a prototype implementation for a parallel and distributed logic programming language, OAR, based on contextual logic programming and and-or tree rewriting systems. The OAR project involves two CENTRIA researchers, and entails a cooperation with Philippe Codognet at the University of Paris-VI, Daniel Diaz at the University of Paris-I and Vitor Santos-Costa at the Federal University of Rio de Janeiro (Brazil).

An applied research and development project also started in late 1999, the SIIUE project, whose purpose is to continue the specification and development of a full-scale logic-based information system for the management of academic and other information at Universidade de Évora. This project is funded by Universidade de Évora and initially involves three CENTRIA researchers.

To bridge the Centre's several areas is a long term strategy, and in 1999 we continued the connections made with respect to learning techniques, to natural language processing (intentions and actions in dialogues), to fuzzy logic and constraints. We hope this will result in the fortification of the divers centre's areas, and in improved joint outcomes.

1.2 Subarea: Soft Computing and Autonomous Agents

The activities of the Soft Computing and Autonomous Agents subarea in 1999 were developed according to the plan in most of its aspects.

Research was carried on in the topics of: Navigation of mobile robots; Formulation of optimization heuristics; Fuzzy optimization using genetic algorithms; Fuzzy multiple criteria decision making; Fuzzy constrained problem enrollment and solving; Data mining; Clustering; Fuzzy behaviour control for autonomous vehicles; Distributed genetic algorithms.

Some of the above topics are oriented towards the support of specific applications, such as: Application of fuzzy theories in ergonomy; Application of fuzzy multiple attribute decision making in military operations; Compression and data retrieval in text databases; Text mining applied to web pages; Data mining in TV audiences (share prediction and preference enrollment); Signal classification with neural networks (hydrophonic effects and electro-encephalograms).

Four MSc thesis were completed (Pedro Quintas, Mário Marques, Carmen Morgado and Luís Almeida), instead of the six predicted. Also, one paper was published as a result of a MSc thesis presented in 1998 [64].

The 2nd International Workshop on Extraction of Knowledge from Data Bases associated with EPIA'99, 9th Portuguese Conference on Artificial Intelligence in Évora/ Portugal, was organized.

Eight seminars were organized with national and international speakers. Two invited researchers visited us - Professor Boris Mirkin and Professor Douglas Fisher.

The hiring of a post-doc specialized in machine learning, as suggested by the evaluators of CENTRIA, was postponed.

Visits to other research centres were made according to planned.

During 1999 we participated in three national projects (HOCTV, ECO and ACAVA) and one international project (EMOLITE).

1.3 Subarea: Natural Language

Intelligent Information Retrieval was the main goal of the our research activities. It required the integration of various, competences (Portuguese and other languages parsing, machine learning, text mining and information extraction) and techniques (symbolic, logic-based, neural-nets-based soft computing, statistics).

In 1999, we have contributed for partially solving the following problems: Part-of-speech taggers generation, adapted to no matter the language and the text genre; robust parsing of text, including fault finding and fault repairing of either text faults, system faults, or faulty knowledge resources; human-machine interaction and speech acts-based communication among BDI agents; multi-agent architectures for adaptive parsing; clustering of verbs according to their subcategorization preferences; extraction of contiguous and non-contiguous patterns from simple and annotated text (word patterns, character patterns, Part-of-speech tags patterns) and application to automatic construction of terminologies and to IR systems for helping users to learn about the content of texts they are looking for; parallel texts alignement and translation equivalents extraction; construction of contemporaneous and medieval text collections POS-tagged and partially parsed, etc.

Dissemination of obtained results was an important concern. As a consequence 24 papers were produced as well as the proceedings of the fourth PROPOR (Processamento computacional de Português escrito e falado), that took place in Évora, Sepetember 1999. One of those papers was published in a Journal, 3 were published as book chapters.

Praxis projects JUSTICA and DIXIT were completed and their final reports are currently available.

Collaboration with statisticians was re-enforced for supporting on-going work on text alignment and translation equivalents extraction and on statistically based classification of documents.

Collaboration with additional Brazilian universities was prospected in order to further reinforce this important co-operation. New areas and possible collaborations were identified: on syntactic checking, with Universidade Federal de São Carlos (S. Paulo) and Mycrosoft-ITAUTEC; on distant learning with Universidade Federal do Espírito Santo, at Vitoria, Universidade Federal de Santa Catarina, at Florianopolis, Pontificia Universidade Católica do Rio Grande do Sul and Universidade Federal do Rio Grande do Sul, both at Porto Alegre; Digital Libraries with UNISINOS, near Porto Alegre, Rio Grande do Sul, Brazil. In Portugal, a similar effort was made.

A new demo project was launched with IGM (Instituto de Geologia e Minas) in order to demonstrate current capabilities on user friendly information retrieval from reports on ore prospection, by helping users to discover the concepts and documents they were looking for, even when they know very little about the subject matter they are searching. In this project it was planned a first integration of the Geographic information system existing at IGM and the Information Retrieval system prepared for handling ore prospecting documents (a preliminary demo is working at: http://coluna.di.fct.unl.pt/~ igm).

An important effort was done in order to star working on audio material and an European project GENMORE (GENeric MORpholexiacl Engine for interactive multilingual multimodal language I/O systems) was proposed by Dafidd Gibbon of the University of Bielefeld. This project was classified very-good but was not selected for funding. Among the partner there was the University College of Dublin, University of Antwerp, Lernout and Hauspie, University of Venice, University of Essex/Brighton, Ljublianss Josef Stepan Institut, a small polish enterprise and CENTRIA. Other contacts have been done in order to launch other projects in future calls for proposals.

Contacts were established in order to launch a Laboratory dedicated to Language technologies and multilingual and multimodal man-machine interfaces. These contacts included specialists on speech processing, graphics processing, video indexing, machine learning and other co-related subject matters, namely software engineering and parallel and distributed architectures, as the systems we should construct get more and more complex and require complexe architectures and appropriate methodologies for handling the problems posed by complexity. Contacts with enterprises were also carried out.

1.4 Subarea: Constraints

During 1999 there were significant advances on the research on Constraints within CENTRIA, based on the work of a number of post-graduate students. More specifically, we can enumerate theoretical work on finite domains, and on linear and non linear constraints over the reals, together with its use in some applications. As a result, this subarea has produced 6 papers published in International Conferences. A more detailed report follows.

Constraint propagation methods were applied for handling differential equations, namely parametric ones (Jorge Cruz). We have applied these type of constraints to model a number of biomedical models, namely to model the conduction of nerve pulses by the peripheral nerve system, and to address compartmental models for the insulin-glucose interaction, of special interest for diabetic patients. We have shown the importance of maintaining a more complete type of consistency on a network of constraints to be able to take safer decisions. This led us to propose the notion of "global hull consistency" and an algorithm to maintain it.

To speed up the computation, we have decided to continue the development of this work in the new language OpAC, developed at Nantes, by the group of Frédéric Benhamou. We also discussed with Pascal van Hentenryck our mutual interest on handling constraints over differential equations. Both these collaborations were anticipated in our plan of activity for 1999. Regarding this plan, it was not possible to discuss with our colleagues in Grenoble a joint project to use our techniques in other applications, namely economic models.

Still in the domain of the reals, we have developed a technique to handle a specific type of distance constraints, arisen in the problem of determination of protein structure from Nuclear Magnetic Resonance data (Ludwig Krippahl). Although one might consider more complex constraints to model this application (e.g. constraints over angles, constraints over several atoms) in our initial approach we considered solely distance constraints and applied a new method for

modeling the domains of the atom positions and propagate the constraints. Supplemented with a simple local optimization this technique achieved very good results: it is about 100 times faster than current competing techniques (simulated annealing) albeit the results produced are still of lower quality.

A quite different approach was exploited to correct problems of linear constraints over the reals which are infeasible (Paula Amaral). The new approach is fully algebraic, not based on propagation, and is based in the total least square methods, using the single value decomposition of the constraints matrix. We were able to show an iterative method that reaches a local minimum on the amount of corrections required. Moreover, this work was presented in a visit that Paula Amaral made to the William and Mary College, where there started a collaboration with Michael Trosset regarding the alternative dependent of these problems as non linear programming.

In the topic of finite domains, we continued to exploit the alignment of faults in digital circuits with constraints over an 8-valued logic, whose values denote dependency on sets of faults. In this respect we have improved our solving of diagnostic problems in these circuits (i.e. generate input test patterns that not only detect at the output the existence of a fault, but that can also show at the output which of two sets of faults is possible) by implementing a first version of a specialized constraint solver for this domain.

Moreover we started our cooperation with a group in INESC led by João Marques Sliva with important work in this subject and discussed the types of problems that are currently important to Electronic Computer Aided Design (ECAD). We identified some optimization problems of interest and have shown that these problems can be modeled by means of set constraints. We thus started the implementation of a constraint solver for this new domain.

Regarding deviations of our plan, the collaboration with Grenoble on applying differential equations constraints to address economic models could not be started. Neither was started the collaboration with IC Parc, which was postponed for 2000. There were no M.Sc. student available to apply constraint technology for resource management applications. Given the state of development of the research work in this group, we were not able to do any significant collaboration with the other research groups in CENTRIA, although we have had some informal and fruitful discussions.

1.5 Subarea: Cognitive Science

The strategy established for this subarea in CENTRIA's original plan of 1997, though implemented with unexpected difficulties and some slowing down, has been nonetheless pursued. The absence, in practice, of one of the senior members of the research team, caused some impairment in its overall performance. Nevertheless, the growth in potential of the CS subarea, in 1999 was significant.

In 1999, the CS subarea continued supporting, and simultaneously benefiting, from the academic intervention of the members of the subarea in the Course in Cognitive Science within the Licenciatura of Engenharia Informática and within the MSc in Applied Artificial Intelligence. As announced in the plan for 99, the paper on "Musical Cognition and Musical Analysis" has been delivered at the Symposium in Vienna and will be published.

As planned, in 1999 the research convergence of interests and consequent collaboration within CENTRIA and FCT-UNL took place. Although the results will become fully visible only in the year 2000 (a co-supervision of a doctorate in CS-motivated subject, and negotiations with the ergonomic team of the Faculdade de Motricidade Humana, involving Professor Francisco [cf. Plan for 2000]), collaboration has been stimulated, as planned.

Two dissertation projects (one PhD and one MSc enrollments) were submitted and approved at FCT/UNL: the PhD is on Agents, Social Behaviour, and Artificial Intelligence, whereas the MSC dissertation is on Cognitive Models in Evolving Robotics. In the sequel of these two subjects, two research projects will be submitted to the Sapiens'99 programme: MEDIATOR - Programação de um Agente Conversacional Discursivo em Ambientes de Comércio Electrónico [MEDIATOR: a Conversational Software Agent using Portuguese Language]; and K-SOPHIA : da Robótica Evolutiva à Cognição Natural [K-SOPHIA: from Evolutionary Robotics to Natural Cognition]. Irrespective of the success or failure of these two project proposals, the social dimension of cognitive processes

and the foundational models of cognition will be research directions to be explored.

Jorge Simão, another PhD research student, is working on CS-oriented Evolutionary Psychology. A theoretical approach as been made to the concept of *cognitive history* [cf. R. Netz] and an application of it developed in a *cognitive history of science* approach to a portuguese mathematician [cf. Plans for CS in 2000].

The internationalization of the activities of the CS-subarea was pursued as well. The paper on "The Logical Impingement of AI", was published in 1999 in a well-known philosophy journal and will be subject to an extended publication as a chapter of a book on the history and philosophy of logic. In connection with the above mentioned Dissertations and Projects, the following international visits or contacts were established in 99: Dario Floreano (of École Polytéchnique Féderale de Lausanne), Inman Harvey (COGS, Sussex University), Takashi Gomi (AAI Japan, Prof. at Fukui University) and Adrian Thompson (COGS). MSc student Fernando de Almeida e Costa attended the following conferences and international initiatives: ECAL'99, Fifth International Conference on Artificial Life (Lausanne, September 99), and a unit on behaviour-based, biologically-inspired robotics within the postgraduate course on Intelligent Agents in Robotics there.

Tiago Vaz Maia, a FCT/UNL former student went to Buffalo, USA, for a PhD in CS. CENTRIA counts on him for a reinforcement CS in Portugal.

Based on the activity of 1999, the year 2000 will seek the consolidation of the cooperation among national research teams and projects, the internationalization, and publications will be re-enforced (the main deficit of the subarea so far).

1.6 Organization of Scientific Events

- Pedro Barahona (as Programme Chairman) and José Alferes (as Conference Chairman) organized, in Évora, EPIA'99, the 9th Portuguese Conference on Artificial Intelligence, September 1999.

Two of the events that took place associated with EPIA'99, were also organized, or co-organized, by members of CENTRIA:

- Gabriel Pereira Lopes organized the workshop PROPOR IV, "4o. Encontro para o Processamento Computacional da Língua Portuguesa Escrita e Falada".
- Gabriela Guimarães and Fernando Moura Pires co-organized, together with Alípio Jorge from Univ. Porto, "2nd International Workshop on Extraction of Knowledge from Data Bases - EKDB'99".

1.7 Missions and Visitors

A detailed list with the missions of CENTRIA members as well as a list with researcher who visit CENTRIA during 1999, is presented at the end of this report.

2 CENTRIA 2000 planned activities

Below, each subarea proffers in greater detail its plans for 2000. Here we concentrate on the general policy aspects.

- As a result of the leaving of 3 PhDs, and their students, from the Soft-computing subarea at the start of 2000, its productivity is bound to suffer, inasmuch only one PhD remains behind. However, the hiring of two postdocs for a year, one in Machine Learning, and the other straddling Machine Learning and Natural Language, is expected to mitigate this effect. Also, not all their students left the Centre, and one is expected to complete her PhD in May 2001. He hope as well that other students will rejoin the Centre once they complete their theses. In any case, some ongoing and newly approved projects in the subarea included the remaining PhD, and so they are not lost to the Centre, as cooperation will still continue in the form of joint projects. The Advisory Committee was kept abreast of these developments, and in spite of the attempts to keep the 3 researchers in the Centre the negotiations broke down at the end of 1999. The main reason for their leaving relates do a teaching post promotion in the Computer Science Department that did not go to any of them.

- On the positive organizational side, we expect to incorporate the Constraints subarea into the Soft-computing one (a measure that could not be carried out before) since they share many affinities, and thus the damage is being curtailed. All the more so because a new PhD is expected to pass his examination in July, in the bridging topic of fuzzy constraints. Moreover, the Autonomous Vehicles topic, which was previously associated with the designation of Soft-computing area will be dropped from the name of the subarea.
- Our MSc in Applied AI was reformulated to allow graduate students to complete in a single year after their graduation by letting them take the master courses as advanced level options at the undergraduate level. This should provide a substantial increment of MSc students. Additionally, more courses are being offered in the MSc, in a total of 15. Details can be found at: http://ssdi.di.fct.unl.pt/~ miaa
- We expect that the emerging Cognitive Science subarea to acquire more momentum, given the increase in availability of a senior researcher who until now was to busy with his pro-rector commitments. Moreover, there are now 4 PhD students working the subarea, plus another one at Berkeley.
- We have started to discuss a possible proposal to the Ministry of Science and Technology with a view to establish CENTRIA as an Associate Laboratory (according to the recent legislation) in the area of "AI, Language, and Cognition". This will permit us to grow and have access to a higher level of funding.
- Several additional cooperations with companies have and will be launched.
- We remain committed to the goal of asserting CENTRIA as the largest AI centre in Portugal.
- We responded to a call for projects of the national programme SAPIENS at the beginning of 2000, with several new projects. Results are expected towards the end of July.
- We will redesign and configure CENTRIA's web site to provide it with greater functionality.

2.1 Subarea: Knowledge Representation and Reasoning, and Logic Programming

The work will be carried out in the context of the ongoing scientific projects: PRAXIS MENTAL - An architecture for mental agents (a final report of the 3-year MENTAL project is due at the end of 2000); PRAXIS OAR - Object-oriented And-Or tree rewriting systems; PRAXIS TARDE - Tabulation and revision in a distributed Prolog environment; NSF/FLAD REAP - Reasoning in Logic Programming. And the application projects: National Parliament BACO - Automatização de Regras Protocolares para Planos de Mesa em Actos Oficiais (Sitting arrangements configuration at official banquets) - under negotiation; AdI/PARAREDE NetBE - Electronic Commerce and Web Banking; SIIUE - Logic-based information system for the management of academic and other information; a US patent on "Personalized Cable Channel Architecture" will be lodged; SAPIENS AJUDA (submitted) - "A Cooperative Multimodal System for Juridical Information Retrieval", using KRR and LP techniques to represent juridical information and model cooperative behaviour in web agents.

At the end of 2000 a national call for projects under the SAPIENS programme is expected, to which we will apply with a sequel project to MENTAL, and other projects not yet defined.

Our research in 2000 will concentrate on:

- Completing our overall mental agents architecture by introducing into the framework: the combination of preferences and updates, the combination of belief revision and updates, the combination of genetic algorithms with logic based learning, the combination of argumentation and cooperation, and the extension of updates to multiple dimensions and multi-agents.
- Providing implementations of the foregoing, and of ABDUAL, a procedure for well-founded semantics with abduction.
- Carrying out applications in diagnosis, standardization learning, software reconfiguration, information retrieval and text mining.
- Implementing distributed tabling in a multi-threaded context.

- Logic-based computational models for distributed shared-memory multiprocessor architectures, integration of object-relational databases and logic programs, development of a Java constraint programming toolkit, development of tools to use Prolog as a WWW scripting language.
- Work on the SIIUE project should develop along the lines of its schedule, in particular the logic-based ISCO language for information systems programming is expected to become fully defined and implemented. Also within the scope of this project, it is expected that the AJACS constraint programming toolkit for Java attains its first usable prototype implementation.

Progress on the OAR project should result in collaboration visits to Philippe Codognet (U. Paris VI), Daniel Diaz (U. Paris I) and Vitor Santos-Costa (UFRJ).

Other collaborations involve the State University of New York at Stony Brook, the University of Maryland, Universities of Bologna and Ferrara, the State University of California at Riverside, the Technical University of Vienna, the University of Linköping.

We will chair the Knowledge and Representation and Non-monotonic Reasoning stream at the Computational Logic 2000 conference in July, London. We will co-chair the Logics in AI workshop in September, Málaga. Both these meetings will have their proceedings publish in the Springer Lecture Notes series.

We will give a course on the "Semantics of Logic Programming and Non-monotonic Reasoning" at the European Summer School on Language Logic and Information 2000 (ESSLLI'00), in August, Birmingham. We will give a course on "Reasoning and Acting with Logic Programming" at the University of Bahia Blanca, December, Argentina.

2.2 Subarea: Natural Language

Gabriel Pereira Lopes and Nuno Marques (September 15-16) will organize a series of tutorials on "Extraction of Information from Text". They will culminate a week dedicated Machine Learning applied to Natural Language which will include the 5th International Colloquium on Grammatical Inference (ICGI-2000) (September, 11-13), chaired by Prof. Arlindo Oliveira from IST/UTL, the 2nd Learning Language in Logic Workshop (LLL 2000) (September, 13-14) and the Fourth Workshop on Computational Natural Language Learning (CoNLL 2000) (September, 14). The tutorials will be taught by: Raymond Mooney (University of Texas at Austin), Walter Daelemans (from the Antwerp University, Belgium) and Gregory Grefenstette (from Xerox Parc at Toulouse, France), Gabriel Pereira Lopes, Nuno Marques, Joaquim Ferreira da Silva, Gael Dias, António Ribeiro, Vitor Rocio and Alexandre Agustini (all members of the Natural Language group of CENTRIA).

Investment in post-graduation will be continued, namely in the Masters Course in Artificial Intelligence (with three disciplines: Natural Language Processing I and II, and Corpus Linguistics), in the Masters Course on Informatics Engineering (with the discipline of Information Extraction from Text), and in the Masters Course of Linguistics (area of Processing and Technologies of Natural Language) of Faculdade de Letras of Universidade de Lisboa (with the discipline: Machine Learning applied to Natural Language).

Collaboration with CITI, the other centre of our department, is planned on: software engineering matters, graphics computing, distributed architectures and multimedia information systems. Collaboration with Machine Learning experts (both inside and outside CENTRIA: at CRI/FCT/UNL and at Coimbra and Oporto Universities) and Statistics experts (both at FCT/UNL and at ISA/UTL) is also planned.

As a consequence of the work programmed along the last few years, during 2000, we plan to continue and finish on-going projects and participate in the elaboration of a few project proposals to submit to national programmed calls and European calls, in the framework of IST programme.

In 2000, apart from two Ph.D thesis that were defended in January and March (they were delayed from 1999, due to schedule problems) four other Ph.D. thesis will be finished of which at least three will be discussed in 2000.

During 2000 we will be working on the following subject matters:

- Adaptive parsing: the impossibility to fully parse sentences will signal possible faults in the lexicon, in the POS-tagged documents or in the input text. Partial parsing based fault finding and fault correction, assuming a multi-agent system architecture, will lead to evolving lexica. By extending the part-of-speech tagger we have constructed, taking into account work on Inductive Logic Programming (at CENTRIA) Multistrategy Learning (at LIACC-Universidade do Porto) and loglinear-based verbal subcategorization learning, a bottom-up approach to enrich existing grammars may be envisaged.
- Statistically-Based Information Extraction from text of: multi word lexical units as support for terminology construction; single and multi-word lexical units morphologic information; single and multi-word lexical units classification in subcategorization classes; single and multi-word lexical units selection restrictions; sub-language grammars; automatic thesaurus construction; text mining (knowledge about the world extraction from texts); document classification, using statistics and soft computing techniques: applications to summarization and information retrieval.
- symbolic and statistical methods for pragmatic interpretation of texts: anaphora resolution, pp-attachment, adjectives attachment, relative clauses attachment;
- Dialogue handling: if possible, this work will proceed in close connection with the European IST project recently approved (SIRIDUS) which continues the Language Engineering European project, TRINDI. Results obtained by Paulo Quaresma, Michael Móra, and Berilhes Garcia in the framework of their Ph.D. thesis as well as joint work by Paulo Quaresma and Irene Rodrigues may greatly enhance expected results in SIRIDUS. Intelligent (Cross Language) Information Retrieval (CLIR) will be an important application;
- Translation equivalents extraction from statistically aligned parallel corpora on specific subject matters and for no matter the pair of languages considered: together with automatic thesaurus construction, these results will enable intelligent CLIR;
- Web based intelligent and friendly information retrieval (IR) integrated with other kinds of Information systems that usually do not integrate the IR component: GIS, virtual musea, digital libraries.
- Start a strategic partnership with Portuguese Government, by proposing the launching of an Associated Laboratory, in order to enable web-based access and management of written information produced by various Ministries and Public Services. This involves bringing together into this partnership SMEs willing to work on Information Retrieval (IR), OCR, on Graphics, and Cross-Language Information Retrieval (CLIR). If feasible we will bring in Radio and TV companies as they have available audio and parallel teletext which will be quite useful for Portuguese pronunciation learning, using alignment techniques already used on parallel text alignment. This requires the association with a strong group on speech recognition and synthesis.

2.3 Subarea: Soft Computing

The objectives for 2000 will be a continuation and extension of the research work in this area, however with some internal changes. This is due to the fact that three subarea members have left the center, leading to an attenuation of the research, especially in the area of Autonomous Agents and Fuzzy Systems. Notwithstanding, we expect a continuation of the research work in the area of Fuzzy Clustering with the remaining of a PhD student. In addition, present as well as future research projects will provide a continuity in the research activities with former members of the group. We also expect contributions to this research area by new post-graduated students from the MIAA (Mestrado em Inteligência Artificial Aplicada), providing additional support for research activities. These research activities will also be promoted by seeking to hire two highly specialized post-docs in the area of machine learning, as well as in the area of machine learning and natural language processing, with the strategic funding already allocated.

The research work in the area of neural networks for temporal pattern discovery and mining will be continued, especially within the application of TV audiences for modeling audience preferences. This work is supported by the PRAXIS project HOC-TV (Heuristic Optimization of Clustering:

Case study of TV audience preferences). An extension of this work to other application domains, such as financial risk analysis, will be investigated within PRAXIS project TSAM (Time Series Analysis and Mining for Financial Risk Management).

The research work in the area of Fuzzy Clustering is part of an ongoing Ph.D. dissertation, that will be finished in the next year. A framework for fuzzy clustering is proposed based on a model of how the data are generated from a cluster structure to be identified: this is called the framework of *"clustering as data modeling"*. The proposed model fits to characteristics (say, structural/functional) of the knowledge domain. During this year, the research work will be consolidated with a more extensive experimental study and part of the Ph.D. dissertation will be written.

Within CENTRIA this area plans to collaborate with the natural language area, as already proposed in the context of the projects in 1999. Especially, unsupervised learning algorithms, such as Self-Organizing Maps together with special visualization techniques, will be used for text mining. In addition, an extension of the developed work in the area of neural networks for temporal pattern discovery will be made towards protein or DNA sequences or structure analysis, in collaboration with the Constraints group. Here, we also intend to start a collaboration with the Department of Statistics, University of Dortmund, Germany.

The leaving of a PhD student in the area of genetic algorithms and distributed systems lead to a reformulation of the aims of this research area.

New research activities, expected to continue, have already started in the area the joint area of agents, genetic algorithms, and contradiction removal by learning in inductive logic programming. The area of machine learning has also been extended to apply inductive logic programming to data cleaning.

Also, a formal framework integrating soft computing approaches (fuzzy, probabilistic, possibilistic, hybrid reasoning) with logical reasoning is expected.

Other activities that this area will promote in 2000 are: work related to the organization of the International Symposium of Intelligent Data Analysis'2001 in Lisbon/ Portugal; visits to foreign universities, such as Universität Dortmund, Germany and Bergische Universität Wuppertal, Germany; invitation of international researchers to visit this area and, if possible, to spend some time working here. We already scheduled the visit of Professor Gerhard Arminger, Bergische Universität Wuppertal, Germany.

We believe that fulfilling the planned objectives and activities will lead to a continuation of research work in this area and strengthen the collaboration with the other subareas.

2.4 Subarea: Constraints

During 2000 the research in the topic of Constraints will still be mostly based on the research work of 4 Ph.D. students. Nevertheless, it is expected that the group will include a new Ph.D., (João Moura Pires) that is about to finish his thesis on Fuzzy Constraint Solving. Specifically, the workplan for 2000 in the Constraints group includes the following actions.

The work on non linear constraints over the reals (Jorge Cruz) will address the problems of developing more efficient algorithms to maintain global hull consistency, and integrate them into the methods used to handle (parametric) differential equations. The first algorithm that was developed was relatively naive, as it did not explore the nature of the constraints. We therefore plan to use some type of local search to speed up the process. Moreover, we expect to integrate this new algorithm to maintain global hull consistency into the work on differential equations as these are some of the applications that will require such demanding criterion of consistency. As explained in the 1999 report we took the decision to adopt OpAC as the language to develop these solutions, an we anticipate further collaboration with the Nantes group. In particular, there will be a short visit to CENTRIA by Frédéric Benhamou, where these ideas will be discussed.

Another area where local search already is and will further be applied is in the protein application (determining 3-D structure from NMR data). Our initial modeling abstracted all the knowledge into distance constraints and applied a specific propagation method. This was mostly developed for the M.Sc. dissertation of Ludwig Krippahl, evaluated in early 2000, but produced

results with poor quality as it would not keep some angle constraints on the atom positions.

In 2000, we plan to change the local optimization that was used on atom positions, and replace it by local optimization on the angles formed by the atoms positions, which will produce solutions which are satisfactory from a chemical viewpoint. We also intend to compare the results we obtained with constraint propagation with those obtained in Computational Distance Geometry. We hope that the planned visit by Michael Trosset (William and Mary College, Va. USA) will enable the discussion and collaboration on this topic. We also expect to start collaboration with Thomas Diettrich (Oregon State University) that has shown interest in using some form of automated learning to direct the enumeration of the domains of the atom positions during the constraint propagation phase.

As to the correction of linear programs (Paula Amaral) we plan to further develop both the theoretical results and a practical implementation of the approach she has taken based on the total least square methods. As mentioned in the 1999 report, we plan to compare this method with a more conventional one that considers the problem of minimal correction of the model as a non-linear minimization problem. In particular we will be interested in discussing with Michael Trosset (William and Mary College, Va. USA) the relationship between the two approaches and whether they can be hybridised in any way.

In addition we plan to exploit an alternative modeling of the problem of correction by considering multiplicative error factors rather than additive ones. The major advantage of this modeling is that a constraint with a zero coefficient on some variable, will keep this coefficient as zero in the corrected model. Hence, the intended meaning that the constraint is independent from that variable is maintained in the corrected model.

In the topic of digital circuit modeling, we plan to move from the 8-valued logic modeling (where only some minor developments are expected) into the modeling by means of set constraints. In 1999 we have tried to use the language Conjunto, build on the Eclipse CLP systems, but we found that, in addition to several minor bugs that kept its use very time consuming, Conjunto was not using very actively the information about the cardinality of the set variables. We therefore plan to implement a new constraint solver over the sets that may take this information into account thus pruning significantly the search space of many set constraints problems. In particular, we hope this new constraint solver will be useful to handle the set constraints generated by the problems on digital circuits (diagnosis and optimization). This research will hopefully continue our collaboration with the INESC group led by João Marques Silva, and formalise it by means of a joint project to be submitted in 2000, where the constraint propagation and the boolean satisfiability methods would be compared..

Given our increasing interest in integrating constraint solving with local search used in non-linear optimization, we plan to start in 2000 a collaboration with PUC, the Pontifícia Universidade Católica do Rio de Janeiro, Brazil, more specifically with the group of Celso Ribeiro. We hope to be able to visit Brazil in 2000 and set up a formal collaboration, that will possibly involve the new member of the group, João Moura Pires, in solving a number of constraint problems by the two different approaches (local search and constraint propagation) or even by some hybridisation of them.

2.5 Subarea: Cognitive Science

Despite the difficulties of 1999, the non impressive but firm development of 99 may allow a more promising year 2000.

The international links with COGS (University of Sussex, UK), P. Strandt (University of Aarhus, Denmark), Takashi Gomi (Japan), through European projects (such as The Society of Knowledge, to be coordinated by the University of Múrcia, Spain) and IberoAmerican Networks (such as the one coordinated, once more, by the University of Múrcia and which includes Universities from Italy, Brazil, Argentina, Mexico, Venezuela,) will be an emphatic aim. The tentative links developed in 99 will obviously require a convergent initiative: the Cognitive Science subarea will prepare, during the year 2000, an international event to be held in the second half of 2001, on *Major Trends in Cognitive Science*. Senior researchers such as David Cliff, Andy Clark, Jean

Petitot, Inman Harvey, Adrian Thomson, David Floreano, Takashi Gomi, Tim van Gelder, will be invited. Tiago Vaz Maia, a CENTRIA collaborator, now a PhD student at SUNY Buffalo in Cognitive Science, will be a valuable contact for the organization of this international event. The MSc student Fernando de Almeida e Costa will attend the ICES2000 (*3rd International Conference on Evolvable Systems - from Biology to Hardware*, to be held in Edimburgh, on April 2000), and in particular the workshop *Evorob2000*, and the most important worldwide conference on Artificial Life - *the Artificial Life VII*, to be held in Portland, Oregon, USA, July 2000.

Negotiations with the Ergonomic team of the Faculdade de Motricidade Humana, involving Professor Francisco Rebelo are expected to produce fruitful results. Prof. António José Zilhão - of Faculdade de Letras, Departamento de Filosofia, and Sociedade Portuguesa de Filosofia - is also expected to join a submitted project of ours. The visibility of the Cognitive Science is a clear objective for 2000-2001. PhD student Jorge Simão will visit for six months the Center for Adaptive Behavior and Cognition, Max Planck Institute for Human Development, Berlin, starting September 2000.

The book on Concepts and Themes in Cognitive Science, an important part of the nationwide visibility of the group, is finally expected to be published at the very end of 2000. Based on the research work on *Agents, Social Behaviour and Artificial Intelligence* and on *Cognitive Models in Evolving Robotics*, at least two research papers are expected to be written and submitted to an international journal. Pending approval of the two submitted research projects submitted to the national SAPIENS programme at the beginning of 2000 (*MEDIATOR - Programação de um Agente Conversacional Discursivo em Ambientes de Comércio Electrónico [MEDIATOR: a Conversational Software Agent using Portuguese Language]* or (*K-SOPHIA : da Robótica Evolutiva à Cognição Natural [K-SOPHIA: from Evolutionary Robotics to Natural Cognition]*) more publications are expected. Manuel da Costa Leite will submit at least one paper on a theoretical approach to the concept of 'cognitive history' [cf. R. Netz] or the inaugural 'cognitive history of science'. Fernando de Almeida e Costa will write in 2000 a paper on Hardware Evolutivo e Teorias da Cognição (Evolving Hardware and Theories of Cognition), to be published, by invitation, in Análise, a national philosophical magazine.

Two papers other papers have been submitted and accepted for 2000, *Metaphorical Mapping consistency via Dynamic Logic Programming*, to the AISB'00 Symposium on Creative and Cultural Aspects and Applications of AI and Cognitive Science, AISB, Birmingham, England, April 2000; and Psychiatric Diagnosis from the Viewpoint of Computational Logic, to the 7th Int. Conf. on Principles of Knowledge Representation and Reasoning, NMR ws on Abductive Reasoning, Breckenridge, CO, USA, April 2000.

As mentioned on the Report of 1999, year 2000 will mark the consolidation of the cooperation among national research teams and projects in CS, its internationalization, and strengthen publications (the main deficit of the subarea so far).

3 Base Funding for 2000

All values in K PTE.

Central Funding (Managed by the Board)	1732	16% of total
Seminars	232	
Advisory Committee	500	
Services	800	
Other management costs	200	
Assigned individual management by PhD' s	8928	84% of total (687/PhD avg.)
Travel	4000	
Equipment	4928	
TOTAL	10660	(Amount awarded by FCT/MCT)

Breakdown:

Scholarships and technical stuff	800	Services
Current	4732	Travels, advisory committee, and seminars
Consumables	200	Other management costs
Capital	4928	Equipment
TOTAL	10660	(Amount awarded by FCT/MCT)

4 List of ongoing projects in 1999

Name	MENTAL - An architecture for mental agents
Status	Ongoing
Funding Institution	PRAXIS
Principal researcher	Luís Moniz Pereira
Participants	CENTRIA/UNL, U.Evora
Description	A logic programming architecture for rational multiple agents comprising combinations of various modes of reasoning, updating, planning, learning, and applications.
Results	12 publications in 1999. Second year report available from PRAXIS.

Name	RELING - Reseau Programation Logique, Contraintes, Langue Naturelle
Status	Finished
Funding Institution	ICCTI-Portugal and Ministry of Science-France
Principal researcher	Luís Moniz Pereira (Pt) e Pierre Deransart (Fr).
Participants	CENTRIA/UNLA, Univ. Minho, INRIA-Rocquencourt, Univ.Orléans, Univ. Nantes, Univ. Toulouse
Description	Research collaboration centered around joint PhD students in the areas of the project (Logic Programming, Constraints, Natural Language, Reasoning with Uncertainty).
Results	Project ended in February 99, but a number of joint tutelage PhD theses are still underway.

Name	CompulogNet - Network of Excellence in Computational Logic
Status	Ongoing
Funding Institution	ESPRIT - European Commission
Principal researcher	Luís Moniz Pereira
Participants	100 european nodes
Description	Collaboration and promotion on its subject matter in Europe.
Results	Reports, conferences, working groups, road maps, web page, advanced schools.

Name	REAP - Reasoning in Logic Programming
Status	Ongoing (Started: October 96)
Funding Institution	FLAD-Portugal and NSF-USA
Principal researcher	Luís Moniz Pereira
Participants	CENTRIA/UNL and Univ. Stony Brook, NY
Description	Use of Logic Programming theory and implementational technology for reasoning tasks
Results	3 publications in 99. 1 ongoing MSc thesis. 3 mutual visits in 99.

Name	ACROPOLE - ACções e RaciocíniO em ProgramaçãO em Lógica Estendida
Status	Finished
Funding Institution	PRAXIS
Principal researcher	Jose Alferes
Participants	Carlos Damásio, Luís Moniz Pereira, Iara Móra, Vitor Nogueira
Description	The main goal of the project ACROPOLE is the definition of a logic programming language sensitive to stimuli (or triggers), and with action performing abilities too, not just over a program itself but on its environment as well. Also to be defined are its declarative and procedural semantics, and a prototype implementation. The language will be developed as an extension to an existing logic programming language with explicit negation.
Results	Definition of the language and its prototypical implementation. Along the 3 year of the project 27 papers were published.

Name	SAFDM - Simulated Annealing and Fuzzy Decision Making
Status	Completed
Funding Institution	PRAXIS
Principal researcher	Rita A. Ribeiro
Participants	Fernando Moura Pires, Jose C. Cunha, Department of Informatics, New University of Lisbon
Description	Development of specialized optimization algorithms based in genetic algorithms and simulated annealing to solve fuzzy mathematical programming problems.
Results	16 papers

Name	ECO
Status	On-going
Funding Institution	PRAXIS XXI
Principal researcher	Pavel Brazdil
Participants	Fernando Moura Pires(CENTRIA), Faculty of Economy of University of Porto, Department of Informatics and Department of Mathematics from the New University of Lisbon, National Institute of Statistics of the North region.
Description	Application of search and clustering techniques to the automatic extraction of concepts from large databases.
Results	

Name	OAR – Object-Oriented And-Or Tree Rewriting Systems
Status	Started September 1999
Funding Institution	PRAXIS XXI
Principal researcher	Salvador Pinto Abreu
Participants	Lígia Ferreira, 2 scholarship students
Description	Design and development of a parallel and distributed AND-OR tree re-writing system, building on previous experience on the AKL and EAM architectures. The language being targeted is close to Prolog with Contextual Logic Programming. Physical shared-memory and distributed Implementation. Application to the development of an Information System for Academic Organizations incorporating a deductive functionality.
Results	2 papers ([50] and one accepted for publication in 2000)

Name	PGR - Selective Access to the information contained in the Opinions of the Portuguese Republic
Status	Ongoing
Funding Institution	Agência de Inovação
Principal researcher	Gabriel Pereira Lopes
Participants	Heurística, CENTRIA and Procuradoria Geral da República.
Description	Access to the opinions of the Portuguese Republic Attorney (PGR) via web, by incorporating knowledge about Portuguese Language (namely a large lexicon, and multi-word units automatically extracted from the PGR corpus) in the search engine used.
Results	In 1999, work was done in order to represent graphically the context of the interaction for each system user. Work on multi-word automatic extraction continued and was incorporated in the search engine enabling the search to be helped by the system by showing the user the conceptual contents of the whole collection. By working on parallel text alignment and translation equivalents extraction from parallel corpora will enable by the end of the project to have access to European case law by using only Portuguese as a query language. Work has already started on automatic classification of the opinions of Portuguese general attorney. # 25 publications and a demo, together with annual report, are available at: http://coluna.di.fct.unl.pt/˜ pgrd

Name	DIXIT - Multilingual Intentional Dialogue Systems
Status	Ongoing
Funding Institution	JNICT/PRAXIS
Principal researcher	Gabriel Pereira Lopes
Participants	DI/FCT/UNL and Universidade de Évora
Description	Mental State based dialogue control; pragmatic interpretation; identification of the intentions of the interlocutors; behaviour programming taking into account own and others mental states The last ones are assumed); acting (speech and other acts); partial parsing; implicit information (linguistic knowledge) extraction from corpora.
Results	In 1999, work proceed in the areas: adaptive parsing updating and correcting multi-word and single-word lexical entries information; multi-agent architecture for parsing; statistical extraction of patterns (words, characters, POS-tags) from large corpora, no matter the language; extraction of verbal subcategorization frames by using statistical methods from automatically POS-tagged large corpora; statistical alignment of parallel corpora and translation equivalents extraction; progress was also achieved in dialogue management — one Ph.D thesis was defended and another is ready for defense. 25 publications. Two new doctors were produced in the framework of this project

Name	Medieval Portuguese Corpora, automatic POS-tagging and partial parsing of this corpora
Status	Ongoing
Funding Institution	JNICT/PRAXIS
Principal researcher	Francisca Xavier (FCSH/UNL) and Gabriel Pereira Lopes (FCT/UNL).
Participants	FCSH/UNL e DI/FCT/UNL
Description	Reuse of tools built for Contemporaneous Portuguese in texts from the XIIIth e XIVth centuries
Results	In 1999, a neural network based POS-tagger was trained and used for POS-tagging new medieval text; using the grammar of Contemporaneous Portuguese and the parsers constructed, those Medieval Portuguese texts were partially parsed; as a consequence the lexicon of Medieval portuguese was enriched. Methods for extracting multi-word lexical units was used in (Crónica Geral de Espanha). 2 publications were produced.

Name	FUNDAÇÕES - Multi Agent Systems and Natural Language Processing: Foundations and Aplications
Status	Ongoing
Funding Institution	Scientific and Technical Institute for the International Co-operation (ICCTI, PT) and CAPES (BR)
Principal researcher	Gabriel Pereira Lopes (CENTRIA) e Vera Lima (PUCRS)
Participants	CENTRIA; Departamento de Matemática da Universidade de Évora; Instituto de Informática da Pontificia Universidade Católica do Rio Grande do Sul de Porto Alegre, Brazil (PUCRS).
Description	This project was aimed at supporting the co-operation of the proponent teams for the application of Multi-Agents Architectures to Natural Language Processing Systems. This project builds on top of the projects: NALAMAS (BR) and DIXIT, PGR, CORPUS e JUSTIÇA (PT). Additional co-operation will exist on training master's and Ph.D. students.
Results	In 1999, a course was taught by Gabriel Pereira Lopes in the master's programme of Pontifícia Universidade Católica do Rio Grande do Sul,at Porto Alegre, Brazil, on Natural Language processing taking into account multi-agent architectures and multiple knowledge sources that may be always evolving as new text comes into play. A Ph.D thesis co-supervised by Gabriel Pereira Lopes was finished and defended in March 2000. Two publications were produced.

Name	Analysis and Synthesis of sentences in Portuguese and French
Status	Ongoing
Funding Institution	Scientific and Technical Institute for the International Co-operation (ICCTI, PT) and CNRS (FR) - (ICCTI/CNRS Contract 423/France)
Principal researcher	Gabriel Pereira Lopes (CENTRIA) Robert Pasero (LIM/CNRS)
Participants	researchers from CENTRIA and Laboratoire d' Informatique de Marseille (LIM).
Description	This project aims at: designing and developing a kernel grammar description for Portuguese (lexicon, syntax, compositional semantics); integrating this kernel into the system ILLICO; designing and developing an application of the kind DataBase searcheable in Portuguese and French; taking into account context and discourse levels.
Results	In 1999, the adaptation of the ILLICO kernel to Portuguese was almost finished. Currently it works with declarative sentences as well as with interrogative sentences and with relative clauses.

Name	JUSTIÇA - Automatic acquisition of facts that occurred and are described by the decisions of the Supreme Court and Natural Language Interrogation about those facts
Status	Finished
Funding Institution	FCT (ex-JNICT)
Principal researcher	Irene Pimenta Rodrigues
Participants	
Description	Automatic acquisition of facts that occurred and are described by the decisions of the Supreme Court and Natural Language Interrogation about those facts
Results	The main result of this project was the definition of an architecture for an information retrieval system with a cooperative dialogue manager using domain knowledge represented in levels of knowledge. The knowledge levels are obtain from different sources: rules modeling juridical knowledge; rules and facts resulting from the automatic processing (syntactic, semantic and pragmatic analysis) of the descriptive parts of some text documents; facts and rules obtain by automatic building documents clusters with significant labels associated; and the information retrieval level that include the words and expressions that are in each document.

Name	TARDE - Tabulation And Revision in a Distributed Prolog Environment
Status	Started September 1999.
Funding Institution	PRAXIS.XXI
Principal researcher	Carlos Viegas Damásio
Participants	CENTRIA/UNL and CITI/UNL
Description	The combination of tabling systems, revision systems and distributed programming is mandatory and promising. It is expected in this very focused project to cross-fertilize the know-how in the implementation of PROLOG distributed systems with the know-how in tabling systems and revision techniques. This will result in building an advanced and efficient portable distributed logic programming (revision) system, incorporating the most recent semantical and operational techniques currently available.
Results	Work has started on the definition of the algorithms for distributed table completion.

Name	NEUROWEB
Status	Ongoing
Funding Institution	ICCTI and INRIA (France)
Principal researcher	Pedro Barahona (in FCT/UNL)
Participants	CENTRIA (Jorge Cruz) , INRIA (Grenoble) and Centro de Estudos Egas Moniz
Description	Integration of knowledge based systems in an Internet Platform
Results	The DARE system, a system to diagnose neuromuscular disorders, that we had developed some years ago, was updated, namely in its interface, so that it could be used interactively through the WEB. Our french partners from Grenoble (INRIA) have successfully integrated the system within the more general NEUROWEB server. We have been discussing the ways in which this integration could be tested, namely a telemedicine scenario where data is collected by other modules of the system, and subsequently submitted to DARE through the Internet, such that one or more proposed diagnoses are returned to the user. The implementation of the full system is now dependent on the completion of the other modules by the Grenoble partners.

Name	ELSNET - European Language and Speech Network
Status	Ongoing
Funding Institution	ESPRIT - European Commission
Principal researcher	José Gabriel Pereira Lopes
Participants	100 european nodes
Description	Collaboration and promotion on its subject matter in Europe.
Results	Reports, conferences, working groups, road maps, web page, advanced schools.

Name	PRESTIGE - Guidelines in Healthcare
Status	Finished
Funding Institution	European Union (Healthcare Telematics)
Principal researcher	Pedro Barahona (in FCT/UNL)
Participants	Francisco Azevedo (UNINOA/CENTRIA), 30 European partners
Description	To develop technology to support the use of guidelines in medicine. These must be translated into computerized protocols for which there is a need of a specification languages and tools to run them and integrate their use with an electronic patient record. One such tool is a protocol manager that based on the specification of the protocol and the data on the patient records schedules medical acts (in the form of recommendations to the health care user)
Results	The main results of the project were a) the implementation of a protocol manager that takes into account the PRESTIGE protocol and b) the implementation of a prototype protocol for the management of Non Insulin Dependent Diabetes Mellitus (NIDDM) patients. The protocol manager was integrated into the clinical information system developed by CENTIS, a partner of the project, so that protocol state could change whenever relevant information was entered in the patient record. Additionally, such changes in the protocol state was communicated to the clinical information system front end, in order to notify the user about the medical tasks relevant to the management of the patient. This prototype was used to implement the NIDDM protocol. This protocol was based on a guideline for the management of diabetes that is now used in several countries worldwide. In particular, it was adopted in the Portuguese Health Services, and the medical advise regarding the medical knowledge embedded in the protocol that was implemented was supplied by the Health Service Administration of the Lisbon and Tejo Valley Region.

Name	ACAVA - Arquitecturas de Comportamentos Adaptativos para Veículos Autónomos
Status	Finished.
Funding Institution	FCT/UNL
Principal researcher	Luís Correia
Participants	Luís Correia, Pedro Mariano, António Abreu
Description	Study and development of behaviour based control architectures for mobile robots. The architecture models to research should have adaptive capabilities.
Results	Results were produced in two research lines, one regarding a fuzzy behavior model for an autonomous robot and another on the evolution of a pilot for the robot. The first one resulted in the paper[22], and the second one resulted in a MSc thesis (of Pedro Mariano) to be delivered in 2000.

Name	Formações à/pela investigação em Antropologia cognitiva e Etnociências: criação de um pólo português nestes domínios. [Research in Cognitive Anthropology and Ethnosciences : establishment of a Portuguese node.]
Status	1st phase completed; 2nd phase, in progress.
Funding Institution	ICCTI-French Embassy.
Principal Researcher	Portugal: José Rodrigues dos Santos. France: Marie Roué.
Participants	CENTRIA, University of Évora. ISCTE, Lisbon. UMR CNRS 882, MNHN, Paris.
Description	Establishment of an European research network on Cognitive Anthropology.
Results	

Name	Access to information available at OCRed reports on ore prospecting and partial integration of a full text information Retrieval System with a Geographic Information System
Status	Ongoing
Funding Institution	IGM
Principal researcher	José Gabriel Pereira Lopes
Participants	CENTRIA, IGM
Description	Definition of the logical structure IGM reports on ore prospecting; use of that definition for obtaining OCRed reports ; control of OCR quality; automatic extraction of multi-word lexical units from those reports; construction of an information retrieval system using the technology developed in the framework of PGR project for enabling rapid access to the reports relevant for a user query. First attempt for integrating the IGM Geographic Information System with the full text retrieval system built.
Results	No papers were produced yet. A demo was constructed and is currently available at: http://coluna.di.fct.unl.pt/~ igm.

5 List of M.Sc. and Ph.D. students and topics in 1999

5.1 M.Sc. Students

Name	Ludwig Krippahl
Degree	M.Sc.
Topic	Determination of the Structure of Proteins with Constraint Solving Techniques.
Supervisor	Pedro Barahona /Frederic Benhamou (Un. Nantes)
Start date	October 1998
Finish date	January 2000

Name	José Ferreira de Castro
Degree	M.Sc.
Supervisor	Luís Moniz Pereira
Topic	An expert system for diagnosis of the national electrical power distribution network
Start date	October 98
Finish date	September 2000 (Expected)

Name	Sílvia Pinheiro
Degree	M.Sc.
Supervisor	Luís Moniz Pereira
Topic	Management of FCT/UNL research centers and social impact of their projects
Start date	December 1998
Finish date	September 2000 (Expected)

Name	Pedro Lopes Mariano
Degree	M.Sc.
Supervisor	Luís Correia
Topic	Optimization of trajectories in an autonomous vehicle, using genetic algorithms
Start date	October 1998
Finish date	September 2000 (Expected)

Name	Pedro Quintas
Degree	M.Sc.
Supervisor	Luís Correia
Topic	Integrated system for Compression, Indexing, Search and Retrieval of Text from Data Bases
Start date	October 1996
Finish date	March 1999

Name	Mário S. Marques
Degree	M.Sc.
Supervisor	Rita Ribeiro
Topic	Fuzzy decision support system for the management of equipment repairs under battle conditions.
Start date	1998
Finish date	April 1999

Name	Mário Amado Alves
Degree	M.Sc.
Supervisor	Gabriel Pereira Lopes
Topic	Lexicon building for multi-word lexical units and integration with word lexicon for Portuguese.
Start date	1999
Finish date	December 2000 (Expected)

Name	Carmen Pires Morgado
Degree	M.Sc.
Supervisor	Fernando Moura Pires
Topic	Robot Controler basedon a Classifier System
Start date	
Finish date	May 1999

Name	Luis de Almeida
Degree	M.Sc.
Supervisor	Fernando Moura Pires
Topic	Temporal Neural Network
Start date	
Finish date	May 1999

Name	Rogerio Cristo
Degree	M.Sc.
Supervisor	Fernando Moura Pires
Topic	Documents Classification
Start date	
Finish date	December 2000 (Expected)

Name	Nuno Bandeira
Degree	M.Sc.
Supervisor	Fernando Moura Pires/Agostinho Rosas (IST)/ Teresa Paiva (Hospital de Santa Maria)
Topic	Clustering based on Ingormation Theory
Start date	September 1998
Finish date	September 2000 (Expected)

Name	Fernando Manuel de Carvalho Almeida e Costa
Degree	M.A.
Supervisor	Manuel Costa Leite
Topic	Philosophy of Cognition
Start date	October 1998
Finish date	November 2000 (Expected)

Name	João Paulo Portelinha Santos
Degree	M.Sc.
Supervisor	Joaquim Nunes Aparício
Topic	Satelite Image Classification
Start date	
Finish date	February 1999

Name	Vitor Manuel Beires Pinto Nogueira.
Degree	M.Sc.
Supervisor	Carlos Damásio
Topic	Negation in Transaction Logic.
Start date	October 1998.
Finish date	September 2000 (Expected)

5.2 Ph.D. Students

Name	Sérgio Andrade de Freitas
Degree	Ph.D.
Supervisor	Gabriel Pereira Lopes
Topic	Ellipsis and pronoun and definite anaphora resolution
Start date	October 1993
Finish date	December 2000

Name	Jorge Ramos Rocio
Degree	Ph.D.
Supervisor	Gabriel Pereira Lopes / Pierre Boullier (Université de Orléans, France)
Topic	Infra-structure for partial parsing natural language input and for diagnosing possible faults (in the lexicon, pre-processing phases, and in the input)
Start date	April 1995
Finish date	December 2000

Name	Nuno Miguel Cavalheiro Marques
Degree	Ph.D.
Supervisor	Gabriel Pereira Lopes
Topic	Automatic extraction of subcategorization frames from text corpora.
Start date	April 1995
Finish date	December 1999

Name	Michael da Costa Móra,
Degree	Ph.D.
Supervisor	Gabriel Pereira Lopes / Rosa Viccari (UF Rio Grande do Sul)
Topic	Belief, Desire and Intention Models and Systems: reducing the gap between specification and implementation
Start date	March 1996
Finish date	March 2000

Name	João Balsa da Silva
Degree	Ph.D.
Supervisor	Gabriel Pereira Lopes
Topic	Multi-Agent Architecture for declarative fault finding in parsing tasks
Start date	October 1996
Finish date	2001 (expected)

Name	Gael Dias
Degree	Ph.D.
Supervisor	Gabriel Pereira Lopes / Sylvie Guilloré (Université de Orléans)
Topic	Extraction of translation equivalents from parallel corpora (French and Portuguese)
Start date	October 1997
Finish date	2001 (expected)

Name	António Ribeiro
Degree	Ph.D.
Supervisor	Gabriel Pereira Lopes
Topic	Extraction of translation equivalents from parallel corpora (English and Portuguese)
Start date	October 1996
Finish date	2001 (expected)

Name	Berilhes Borges Garcia
Degree	Ph.D.
Supervisor	Gabriel Pereira Lopes
Topic	changeability along the time axis of behavior pressupositions (truthfulness, cooperativity, activity, credulousness), credulidade) of an autonomous agent
Start date	October 1996
Finish date	2000 (expected)

Name	Joaquim Ferreira da Slva
Degree	Ph.D.
Supervisor	Gabriel Pereira Lopes
Topic	Extraction of Multi-word units from text corpora and decision about pp-attachement
Start date	March 1998
Finish date	2001 (expected)

Name	Jorge Cruz
Degree	Ph.D.
Topic	Interval Constraints to handle Differential Equations with Applications to Medicine.
Supervisor	Pedro Barahona /Frederic Benhamou (Un. Nantes)
Start date	October 1997
Finish date	October 2000 (Expected)

Name	Paula Amaral
Degree	Ph.D.
Topic	Adaptation of Overconstrained Linear Constraint Problems
Supervisor	Pedro Barahona
Start date	October 1998
Finish date	October 2001 (Expected)

Name	Francisco Azevedo
Degree	Ph.D.
Topic	Exploitation of Global Constraints in Finite Domain Constraints
Supervisor	Pedro Barahona
Start date	January 1998
Finish date	December 2001 (Expected)

Name	Iara Mora
Degree	Ph.D.
Supervisor	José Alferes
Topic	Argumentation and cooperation in multi-agent logic programming systems, with application to distributed diagnosis
Start date	October 1997
Finish date	2001 (Expected)

Name	João Leite
Degree	Ph.D.
Supervisor	Luís Moniz Pereira
Topic	Architecture for rational agents
Start date	October 1996
Finish date	March 2001 (expected)

Name	António Paulo Duarte Gomes de Abreu
Degree	Ph.D.
Supervisor	Luís Correia
Topic	Development of control architectures for autonomous robots navigation
Start date	September 1998
Finish date	September 2002

Name	João Moura-Pires
Degree	Ph.D.
Supervisor	Rita Ribeiro / Henri Prade (Un. Toulouse)
Topic	Constraint satisfaction problems in a fuzzy environment
Start date	1994
Finish date	2000

Name	Isabel Lopes Nunes
Degree	Ph.D.
Supervisor	Rita Ribeiro
Topic	Fuzzy Ergonomics: an Expert sytem with fuzzy logic
Start date	1996
Finish date	2000 (expected)

Name	Susana Nascimento
Degree	Ph.D.
Supervisor	Fernando Moura Pires/ Boris Mirkin
Topic	Fuzzy Clustering
Start date	May 1995
Finish date	December 2000 (Expected)

Name	Victor Lobo
Degree	Ph.D.
Supervisor	Fernando Moura Pires
Topic	Classification of Hydrophnoic effects
Start date	May 1996
Finish date	December 2002 (Expected)

Name	Teresa Cristina Goncalves
Degree	Ph.D.
Supervisor	Fernando Moura Pires
Topic	Clustering based on Ingormation Theory
Start date	April 1997
Finish date	December 2001 (Expected)

Name	Margarida Cardoso
Degree	Ph.D.
Supervisor	Isabel Themido (IST) / Fernando Moura Pires
Topic	Clustering based on Ingormation Theory
Start date	
Finish date	July 2000

Name	Lígia Ferreira
Degree	Ph.D.
Supervisor	Salvador Pinto Abreu
Topic	Visual Constraint Logic Languages
Start date	June 1999
Finish date	2002 (Expected)

Name	Alexandre Agustini
Degree	Ph.D.
Supervisor	Gabriel Pereira Lopes
Topic	Adaptive Parsing Systems capable of overcoming incomplete lexical knowledge by by parsing large corpora
Start date	September 1999
Finish date	2003 (Expected)

6 Publications

6.1 Edited books

[1] P. Barahona and J. J. Alferes, editors. *Progress in Artificial Intelligence - Proceedings of the 9th Portuguese Conference on Artificial Intelligence, EPIA'99*, volume 1695 of *Lecture Notes in Artificial Intelligence*. Springer-Verlag, 1999.

[2] R. A. Ribeiro, R. Yager, H-J Zimmermann, and J. Kacprzyk, editors. *Soft Computing in Financial Engineering*. Studies in Fuzziness and Soft Computing. Physica-Verlag, 1999.

6.2 Book chapters

[3] V. Rocio e J. G. P. Lopes. *Linguística Computacional: Investigação Fundamental e Aplicações*, chapter Análise sintáctica parcial em cascata. Edições Colibri, 1999. Marrafa e M. A. Mota(eds.). ISBN 972-772-090-0.

[4] V. Rocio e J. B. da Silva J. G. P. Lopes. *Linguística Computacional: Investigação Fundamental e Aplicações*, chapter Superando a incompletude da informação lexical. Edições Colibri, 1999. P. Marrafa and M. A. Mota(eds). ISBN 972-772-090-0.

[5] N. Marques, J. G. P. Lopes, and C. A. Coelho. *Linguística Computacional: Investigação Fundamental e Aplicações*, chapter Extracção Automática de Restrições de Subcategorização a partir de Corpora de textos. Edições Colibri, 1999. P. Marrafa and M. A. Mota(eds.). ISBN 972-772-090-0.

[6] P. Powell and R. A. Ribeiro. *Encyclopedia of Microcomputers*, chapter Uncertainty in Decision Making, pages 335–346. 1999. Edited by: A. Kent, J. G. Williams, Volume 22, supplement 1.

[7] R. A. Ribeiro and F. M. Pires. *Soft Computing in Financial Engineering*, chapter Financial Analysis of Non-Financial Companies with Neural Networks, pages 320–338. 1999. Rita A. Ribeiro, R. Yager, H-J Zimmermann, J. Kacprzyk (eds.). Physica-Verlag, Heidelberg. Series on Studies in Fuzziness and Soft Computing.

[8] D. De Schreye, M. Hermenegildo, and L. M. Pereira. *Compulog Net Roadmap*, chapter Paving the Roadmaps: Enabling and Integration Technologies. 2000. To appear.

6.3 In International Journals

[9] J. J. Alferes, J. A. Leite, L. M. Pereira, H. Przymusinska, and T. C. Przymusinski. Dynamic updates of non-monotonic knowledge bases. *Journal of Logic Programming*, 2000. To appear (camera ready version sent in 1999).

[10] G. Dias, S. Guilloré, J. C. Bassano, and J. G. P. Lopes. Extraction automatique d'unités lexicales complexes: Un enjeu fondamental pour la recherche documentaire. *Jornal Traitement Automatique des Langues*, 2000. To appear (camera ready version sent in 1999).

[11] P. Quaresma J. G. Lopes and I. P. Rodrigues. A dialog system for controlling question/answer dialogues. *Text Processing and Cognitive Technologies*, 1999. Paper Collection. Edited by R.K. Potapova. Moscow, Pushchino.

[12] E. Lamma, F. Riguzzi, and L. M. Pereira. Strategies in combined learning via logic programs. *Machine Learning Journal*, 2000. To appear (camera ready version sent in 1999).

[13] L. M. Pereira. The logical impingement of ai. *Grazer Philosophische Studien*, 56:183–204, 1999.

[14] P. Quaresma and I. P. Rodrigues. Automatic classification and intelligent clustering for WWWeb information retrieval systems. *Journal of Information Law & Technology (JILT)*, 2000. To appear (camera ready version sent in 1999).

[15] R. A. Ribeiro. Fuzzy evaluation of the thermal quality of buildings. *Computer-Aided Civil and infrastructure Engineering*, pages 155–162, 1999.

[16] R. A. Ribeiro and F. M. Pires. Fuzzy linear programming via simulated annealing. *Kybernetika*, 35(1):57–67, 1999.

[17] R. A. Ribeiro and F. M. Pires. Fuzzy site location problems and simulated annealing. *Studies in Locational Analysis*, pages 61–76, June 1999.

[18] V. Rocio, E. de la Clergerie, and J.G.P.Lopes. Tabulation for multi-purpose partial parsing. *Journal Grammars*, 2000. To appear (camera ready version sent in 1999).

[19] J. R. Santos. Les savoirs par-delà les cultures. *Sciences Humaines*, Hors-Série La Dynamique des Savoirs:68–72, 1999.

[20] J. R. Santos. Les savoirs comme champs sémantiquement structurés. *Episteme*, 2000. To appear (camera ready version sent in 1999).

6.4 In National Journals

[21] J. J. Alferes. Inteligência artificial e processos de decisão. *Cadernos de Bioética*, (22), 1999. Invited paper.

6.5 In Proceedings of International Conferences

[22] A. Abreu and L. Correia. Fuzzy behaviors and behavior arbitration in autonomous vehicles. In Pedro Barahona and José J. Alferes, editors, *EPIA'99 - 9th Portuguese Conference on Artificial Intelligence*, volume LNCS, pages 237–251. Springer, September 1999.

[23] J. J. Alferes. Inteligência artificial e psicologia: diferentes abordagens da inteligência. In *Congresso Internacional "Interfaces da Psicologia"*, Univ. Évora (Portugal) / Univ. Extremadura (Spain), March 1999.

[24] J. J. Alferes, L. M. Pereira, H. Przymusinska, and T. C. Przymusinski. Lups - a language for updating logic programs. In N. Leone M. Gelfond and G. Pfeifer, editors, *5th International Conference on Logic Programming and Nonmonotonic Reasoning*, volume LNAI-1730, pages 162–176. Springer, December 1999.

[25] J. J. Alferes, L. M. Pereira, H. Przymusinska, T. C. Przymusinski, and P. Quaresma. Preliminary exploration on actions as updates. In M. C. Meo and M. Vilares-Ferro, editors, *Joint Conference on Declarative Programming (AGP'99)*, September 1999.

[26] J. J. Alferes, L. M. Pereira, and T. Swift. Well-founded abduction via tabled dual programs. In D. De Schreye, editor, *16th International Conference on Logic Programming*, pages 426–440. MIT Press, 1999.

[27] P. Amaral and P. Barahona. After infeasibility in linear program problems. In *Workshop on Integration of AI and OR Techniques in Constraint Programming for Combinatorial Optimization Problems*, February 1999.

[28] J. N. Aparício, L. Correia, and F. M. Pires. Populations are multisets - plato. In Wolfgang Banzhaf, Jason Daida, Agoston E. Eiben, Max H. Garzon, Vasant Honavar, Mark Jakiela, and Robert E. Smith, editors, *GECCO-99 Proceedings of the Genetic and Evolutionary Computation Conference. A Joint Meeting of the Eighth International Conference on Genetic Algorithms (ICGA-99) and the Fourth annual Genetic Programming Conference (GP-99)*, pages 1845–1850. Morgan Kaufmann, July 1999.

[29] N. F. C. Bandeira, V. S. Lobo, and F. M. Pires. Eeg/ecg data fusion using self-organising maps. In *International Conference on Data Fusion - EuroFusion99*, October 1999.

[30] M. G. M. S. Cardoso, F. M. Pires, and I. H. Themido. Unsupervised learning: An evaluation perspective. In *EKDB Workshop: Extraction of Knowledge from Data Bases*, September 1999. Associated with EPIA'99.

[31] C. S. Castelhano, S. R. Barros, R. A. Ribeiro, and A. M. Moreira. Fuzzy intelligent queries on the 500 biggest portuguese companies. In *European Congress on Intelligent Techniques and Soft Computing, EUFIT'99*, September 1999.

[32] L. Correia, F. M. Pires, and J. N. Aparício. Expressing population based optimization heuristics using plato. In *EPIA99 - Encontro Português de Inteligência Artificial*, September 1999.

[33] J. Cruz and P. Barahona. An interval constraint approach to handle parametric ordinary differential equations for decision support. In J. Jaffar, editor, *Principles and Practice of Constraint Programming - CP'99*, volume LNCS 1713, pages 478–479. Springer-Verlag, 1999.

[34] J. Cruz and P. Barahona. An interval constraint approach to handle parametric ordinary differential equations for decision support. In F. Moura Pires, G. Guimarães, and A. Jorge, editors, *2nd International Workshop on Extraction of Knowledge from Data Bases*, pages 93–108, 1999. associated with EPIA'99, 9th Portuguese Conference on Artificial Intelligence.

[35] J. Cruz, P. Barahona, and F. Benhamou. Integrating deep biomedical models into medical decision support systems: An interval constraint approach. In Aalborg, W. Horn, Y. Shahar, G. Lindberg, S. Andreassen, and J. Wyatt, editors, *Joint European Conference on Artificial Intelligence in Medicine and Medical Decision Making*, volume LNAI, pages 185–194. Springer-Verlag, 1999.

[36] J. F. da Silva, , and J. G. P. Lopes. A local maxima method and a fair dispersion normalization for extracting multi-word units from corpora. In *Sixth Meeting on Mathematics of Language (MOL6)*, pages 369–381, July 23-25 1999.

[37] J. F. da Silva and J. G. P. Lopes. Extracting multiword terms from document collections. In *VExTAL: Venezia per il Trattamento Automatico delle Lingue*, November 22-24 1999.

[38] J. F. da Silva, J. G. P.Lopes, M. F. Xavier, and G. Vicente. Relevant expressions in large corpora. In Cécile Fabre et Marie-Paule Péry-Woodley Anne Condamines, editor, *Actes de l'atelier - Corpus et Traitement Automatique des Langues: Pour une réflexion méthodologique (TALN'99)*, pages 86–94. ATALA, July 12-17 1999.

[39] C. V. Damásio and V. B. Nogueira. Negation in transaction programs. In *Joint Conference On Declarative Programming (AGP '99)*, September 1999.

[40] C. V. Damásio, L. M. Pereira, and T. Swift. Coherent well-founded annotated logic programs. In N. Leone M.Gelfond and G. Pfeifer, editors, *5th International Conference on Logic Programming and Nonmonotonic Reasoning*, volume LNAI, pages 262–276. Springer, December 1999.

[41] V. S. de Lima, A. Carvalho, R. Wazlawick, J. Sichman, R. Viccari, F. Moreira, and J. G. P. Lopes. Nalamas - natural language multi-agent systems: studying the subject through nalamas project. In Celso Costa Virgílio Almeida and Rosa Viccari, editors, *ProTeM-CC - Phase III Projects - International Evaluation Workshop (ProTeM-CC'99)*, pages 73–98. CNPq - Conselho Nacional de Desenvolvimento Científico e Tecnológico, 5-7 May 1999.

[42] P. Dell'Acqua and L. M. Pereira. Updating agents. In S. Rochefort, F. Sadri, and F. Toni, editors, *ICLP'99 Workshop on Multi-Agent Systems in Logic (MASL'99)*, 1999.

[43] G. Dias, S. Gilloré, and J. G. P. Lopes. Mutual expectation: a measure for multiword lexical unit extraction. In *VExTAL, Venezia per il Trattamento Automatico delle Lingue*, November 22-24 1999.

[44] G. Dias, S. Guilloré, and J. G. P. Lopes. Language independent automatic acquisition of rigid multiword units from unrestricted text corpora. In Pascal Amsili and Phileppe Blache, editors, *6th. Annual conference on Traitement Automatique des Langues Naturelles (TALN99)*, pages 333–338, July 12-17 1999. poster.

[45] G. Dias, S. Guilloré, and J. G. P. Lopes. The multilingual aspects of multiword lexical units. In Spela Vintar, editor, *Language Technologies Workshop*, pages 11–21, July 8-11 1999. organized in the framework of the 32nd Annual Meeting of the Societas Linguistica Europea (SLE99). ISBN 961-227-003-1.

[46] G. Dias, S. Guilloré, and J. G. Pereira Lopes. Multiword lexical unit extraction. In Chen Zhaoxiong, editor, *International Conference on Machine Translation and Computer Language Information Processing (ISMT/CLIP 99)*, pages 119–125, June 26-28 1999.

[47] G. Dias, S. Vintar, S. Guilloré, and J. G. P. Lopes. Identifying and integrating terminologically relevant multi-word units in the ijs-elan slovene- english parallel corpus. In Paola Monachesi, editor, *Resumos das Comunicções ao Encontro Computational Linguistics in Netherlands*, page 16, December 10 1999.

[48] M. Ferrand, J. A. Leite, and A. Cardoso. Hypothetical reasoning: an application to optical music recognition. In M. C. Meo and M. V. Ferro, editors, *APPIA-GULP-PRODE'99 Joint Conference on Declarative Programming (AGP'98)*, pages 367–381, September 1999.

[49] M. Ferrand, J. A. Leite, and A. Cardoso. Improving optical music recognition by means of abductive constraint logic programming. In P. Barahona and J. J. Alferes, editors, *Progress in Artificial Intelligence, 9th Portuguese International Conference on Artificial Intelligence (EPIA'99)*, volume LNAI 1695, pages 342–356. Springer-Verlag, September 1999.

[50] L. Ferreira and S. P. Abreu. A constaint logic programming framework in java. In *Workshop on Parallelism and Implementation Technologies*, 1999.

[51] P. Froehlich, C. V. Damásio, W. Nejdl, L. M. Pereira, and M. Schroeder. Using extended logic programming for alarm-correlation in cellular phone networks. In *Twelfth International Conference on Industrial and Engineering Applications of Artificial Intelligence and Expert Systems IEA/AIE-99*. Springer-Verlag, May 1999.

[52] P. Fröhlich, I. Móra, W. Nejdl, and M. Schroeder. Diagnosis agents for distributed systems. In J. J. Meyer and P.Y. Schobbens, editors, *Formal Models of Agents*, volume 1760 of *LNAI*, pages 173–186. Springer, 1999.

[53] T. C. Gonçalves, C. Brito, and F. M. Pires. Tv audience analysis and prediction. In *CIMA'99 - Proceedings of the ICSC Congress on Computational Intelligence Methods and Applications, ICSC - International Computer Science Conventions*, June 1999. on CDROM.

[54] T. C. Gonçalves, C. Brito, and F. M. Pires. A tv audience prediction model. In *PAKDD'99 3rd Pacific-Asia Conference on Knowledge Discovery and Data Mining*, April 1999.

[55] G. Guimarães. The extraction of temporal knowledge from multivariate time series using self-organized neural networks. In *Analysis of Time Series in Goods Management and Production Systems*, Junho 1999.

[56] G. Guimarães. Method for temporal knowledge conversion. In *Risk Management Meeting*, Junho 1999.

[57] G. Guimarães. Temporal knowledge conversion - the extraction of temporal knowledge from multivariate time series. In F. Moura-Pires, G. Guimarães, and A. Jorge, editors, *Extraction of Knowledge from Data Bases. Procs. of the 2nd Intl. Workshop EKBD́99*, pages 65–88, 1999. Associated to the EPIA99, 9th Portuguese Conference on Artificial Intelligence.

[58] G. Guimarães and A. Ultsch. A method for temporal knowledge conversion - advances in intelligent data analysis. In D.J. Hand, J.N.Kok, and M.R. Berthold, editors, *IDA99, The Third Symposium on Intelligent Data Analysis*, volume LNCS 1642, pages 369–380. Springer, August 1999.

[59] L. Krippahl and P. Barahona. Applying constraint propagation to protein structure determination. In J. Jaffar, editor, *Principles and Practice of Constraint Programming - CP'99*, volume LNCS 1713, pages 289–302. Springer-Verlag, 1999.

[60] L. Krippahl and P. Barahona. Mixed constructive-reparative solving for protein structure determination. In F. Moura Pires, G. Guimarães, and A. Jorge, editors, *2nd International Workshop on Extraction of Knowledge from Data Bases*, pages 109–123, 1999. associated with EPIA'99, 9th Portuguese Conference on Artificial Intelligence.

[61] E. Lamma, F. Riguzzi, and L. M. Pereira. Agents learning in a three-valued logical setting. In A. Panayiotopoulos, editor, *Workshop on Machine Learning and Intelligent Agents*, 1999. in conjunction with Machine Learning and Applications, Advanced Course on Artificial Intelligence (ACAI99).

[62] E. Lamma, F. Riguzzi, and L. M. Pereira. Learning three-valued logic programs. In S. Dzeroski and P. Flach, editors, *Late breaking papers proceedings of the Ninth International Workshop on Inductive Logic Programming (ILP'99)*, pages 30–35, June 1999.

[63] N. Marques, J. G. P. Lopes, and C. A. Coelho. Mining subcategorization information by using multiple feature loglinear models. In Paola Monachesi, editor, *Resumos das Comunicções ao Encontro "Computational Linguistics in Netherlands"*, page 36, December 10 1999.

[64] P. Monteiro and L. Correia. Traffic management - a multi-agent system approach. In C. Westphall, L. Kormann, M. Notare, B. Riso, and F. Cruz, editors, *IEEE LANOMS'99 - Latin American Network Operations and Management Symposium*, pages 52–63, 1999.

[65] M. Móra, J. G. P. Lopes, H. Coelho, and R. Viccari. BDI models and systems: reducing the gap. In Jorg P. Muller, Munindar P. Singh, and Anad S. Rao, editors, *Agents V*, volume LNAI 1555. Springer, 1999.

[66] S. Nascimento, B. Mirkin, and F. M. Pires. Multiple prototype model for fuzzy clustering. In David J. Hand , Jost N. Kok, and Michael R. Berthold, editors, *Advances in Intelligent Data Analysis. Third International Symposium, IDA-99*, volume LNCS 1642, pages 266–279. Springer Verlag, August 1999.

[67] I. L. Nunes and R. A. Ribeiro. Fuzzy evaluation module of ergo_x. In *IFORS SPC-9 Conference on Intelligent and Active DSS*, pages 92–100, 1999. April.

[68] P. Quaresma and I. Rodrigues. A collaborative legal information retrieval system using dynamic logic programming. In *International Conference on AI and Law'99*. ACM, 1999. Short paper.

[69] P. Quaresma and I. Rodrigues. An information retrieval system with cooperative behavior. In *Nordic Conference of Computational Linguistics - NODALIDA'99*, 1999. To be published.

[70] P. Quaresma and I. Rodrigues. A logic programming framework for cooperative information retrieval. In *ISAS'99 - 5th International Conference on Information System Analysis and Synthesis*, 1999.

[71] P. Quaresma and I. Rodrigues. Pgr: A cooperative legal ir system on the web2. In Graham Greenleaf and Andrew Mowbray, editors, *2nd AustLII Conference on Law and Internet*, 1999. Invited paper.

[72] P. Quaresma and I. Rodrigues. Using dynamic logic programming to model cooperative dialogues. In *AAAI'99 Fall Symposium on Modal and Temporal Logics based Planning for Open Networked Multimedia Systems*, 1999.

[73] P. Quaresma, I. Rodrigues, J. G. P. Lopes, T. Almeida, E. Garcia, and A. Lima. Um sistema de pesquisa de informação para bases de texto em português. In P. Quaresma G. Lopes and I Rodrigues, editors, *Actas do PROPOR IV, IV Encontro para o Processamento Computacional da Língua Portuguesa Escrita e Falada*, 1999.

[74] R. A. Ribeiro and A. M. Moreira. Intelligent query model for business characteristics. In *IEEE/WSES/IMACS CSCC'99 Conference*, July 1999.

[75] V. Rocio and J. G. P. Lopes. An infra-structure for diagnosing causes for partially parsed natural language input. In *ACTAS-I VI Simposio Internacional de Comunicación Social*, pages 550–554. Editorial Oriente, January 25-28 1999. In 6th International Symposium on Social Communication. ISBN 959-11-0250-X.

[76] V. J. Rocio, M. A. Alves, J. G. P. Lopes, M. F. Xavier, and G. Vicente. Automated creation of a partially syntactially annotated corpus of medieval portuguese using contemporary portuguese resources. In Laurent Roussarie, editor, *ATALA workshop on Treebanks (Journees ATALA sur les corpus annotes pour la syntaxe)*, pages 59–67. Association pour le Traitement Automatique des Langues, June 18-19 1999.

[77] J. F. Silva, G. Dias, S. Guilloré, and J. G. P. Lopes. Using localmaxs algorithm for the extraction of contiguous and non-contiguous multiword lexical units. In P. Barahona, editor, *Progress in Artificial Intelligence: 9th Portuguese Conference on AI, EPIA'99*, volume LNCS 1695, pages 113–132. Springer-Verlag, September 1999.

6.6 Other publications

[78] J. G. P. Lopes, I. Rodrigues, and P. Quaresma, editors. *Actas do IV Encontro para o processamento Computacional da Língua Portuguesa Escrita e Falada*. Universidade de Évora, 1999.

[79] F. Moura Pires, G. Guimarães, and A. Jorge, editors. *2nd International Workshop on Extraction of Knowledge from Databases*. Universidade de Évora, 1999.

7 Missions

Luís Moniz Pereira

- Univ. Califórnia at Riverside, USA Dept. Computer Science January-February 99
  Purpose: collaboration on logic program updates (continuation)
  Contact: Prof. Teodor Przymusinski
- State Visit to Ireland of the President of Republic of Portugal Dublin, 1-3 June 99
  Purpose: establish national bilateral academic and business awareness and cooperation
- State University of New York at Stony Brook (SUNY), USA Dept. Computer Science 25-31 July 99
  Purpose: collaboration on logic programmming with abduction, and its application to psychiatric medical diagnosis
  Contacts: Prof. David Warren, Prof. Terrance Swift, Prof. Joseph Gartner, Prof. Allen Tien. Prof. David Warren being a member of the External Advisory Committee of CENTRIA, his advice was sought on a number of issues by the Centre's Director.

Gabriel Pereira Lopes

- Pontifícia Universidade Católica do rio Grande do Sul, Porto Alegre, Brasil Instituto de Informática March 15 April 7, 1999
  Purpose: to teach a course on Advanced topics in Natural Language Processing in the framework of the Masaters Course in Informatics (30 hours course). Moreover, work was done with A. Agustini in order to prepare his Ph.D. programme when he would arrive in Lisbon. Work was done with Michael da Costa Móra, regarding the preparation of the final version of his Ph.D. Thesis. Contact: Prof. Vera Strube de Lima
- UNISINOS, in the area of Grande Porto Alegre Departamento de Informática April 1999
  Purpose: to set up a collaboration on anaphora resolution in large corpora and to evaluate the possibilities for greater collaboration in the area of application of neural networks to NLP Contact: Prof. Renata Vieira
- Universidade Federal de Pelotas, Rio Grande do Sul Departamento de Informática April 1999
  Purpose: To evaluate the possibilities of co-operation in the area of sign languages. Contact: Prof. Antônio Rocha Costa
- Universidade Federal do Espírito Santo, em Vitória, Brazil Departamento de Informática April 8-11, 1999
  Purpose: Given the fact that two Ph.D. students of Gabriel Pereira Lopes are professors at this University, it was important to define future collaboration. The areas of Intelligent Information Retrieval, automatic document classification and Distance Learning were identified as possible areas for future co-operation. Contact: Crediné Silva de Menezes
- Universidade Estadual de São Carlos, São Paulo Brasil Departamento de Informática April 11-12 1999
  Purpose: to increase co-operation in the area of syntactic fault finding and co-operation with ITAUTEC/Microsoft for building a syntactic corrector for European Portuguese. Contact: Prof. Maria das Graças Volpe Nunes.
- Pontifícia Universidade Católica de São Paulo, Brasil Departamento de Linguística April 13, 1999
  Purpose: to present a talk on multi-word lexical units extraction and neural network based POS-tagging of corpora. To discuss the viability of future co-operation with this University in the area of corpus Linguistics Contact: Prof. Tony Berber Sardinha
- Universidade de São Paulo (USP) Computer Science Department April 13, 1999
  Purpose: To present a talk on Multi-agent systems and adaptive NLP systems. Apart from multi-agents, it is also our purpose to evaluate the existence of other areas for future co-operation. The extraction of translation equivalents between Portuguese and Japanese is an area that must be explored as well as multi-agents. Contact: Prof. Jaime Sichman and Jorge Kinoshita.
- Laboratoire d' Informatique de Marseille (CNRS) June 6-13 and October 10-17, 1999
  Purpose: to proceed co-operation in the framework of the project Analysis and synthesis of sentences in Portuguese and French. Contact: Paul Sabatier and Robert Pasero.
- European Commission, Brussels, Belgium July 4-11, 1999
  Purpose: Evaluation of European project proposals submitted to the 3rd IST programme in the area of Human Language Technologies.
- University of Vigo and Xunta de Galicia (Galicia, Spain) July 12-13, 1999
  Purpose: to demonstrate the IR system that is being constructed for the Portugueguese republic General Attourney — PGR and to check on its utility for Xunta de Galicia and on possible co-operation in the European framework. Contact: Manuel Vilares Ferro

Gabriela Guimarães

- Univ. Dortmund, Germany Dept. of Statistics 15-18 Juni 98
  Purpose: collaboration in clustering and genetics Contact: Prof. Wolfgang Urfer
- Bergische Univ. Wuppertal, Germany Dept. of Economics 13-14 Juni 98
  Purpose: collaboration in time series analysis Contact: Prof. Gerhard Arminger

Gael Harry Dias

- Univ. de Orléans, France Laboratoire d'Informatique Fondamentale d'Orléans June 99
  Purpose: RELING project Contact: Prof. Sylvie Guilloré

Paula Amaral

- William and Mary College, USA Dept. of Mathematics October-December 99
  Purpose: collaboration on correction of infeasible linear programs Contact: Dr. Michael Trosset

Jorge Cruz

- Univ. of Nantes, France Dept. Computer Science December 99
  Purpose: Training with the language OpAC, for nonlinear constraints over the reals Contact: Prof. Frédéric Benhamou

8 Visitors

Pierangelo Dell'Acqua , U. Uppsala, Sweden, 3,5 months, January-April 99,. Collaboration on logic programming agent architectures in the context of PRAXIS project MENTAL.

Sten-Ake Tarnlund , U. Uppsala, Sweden, 7 months, January-July 99. Continuation of European Commission TMR scholarship for cooperation on parallel logic programming.

Terrance Swift and Bouoqiu Cui , U. Stony Brook, USA, 2 weeks, September 19 - October 3. Collaboration on abduction in well founded semantics, psychiatric diagnosis, annotated logic programs, and application of assignable variables to relevant tabling and constructive negation.

Fernando Pereira , ATT Labs, New Jersey, USA, 2 days, 25-26 October 99. This member of the External Advisory Committee of CENTRIA was given a run of the Centre's activities, and gave us advice.

Thomas Diettrich , Oregon State University, 3 days, 3-5 March 99. On advice from Dr Fernando Pereira, member of the External Advisory Committee of CENTRIA, we invited Prof Diettrich for an in-depth visit and advice on the Soft Computing area, about which he produced a report.

David Pearce , Saarbruecken, Germany, 5 days, 4-8 October 99. Collaboration with José Alferes in preparing a joint summer school course proposal at ESSLLI'00 (and meanwhile accepted), in Birmingham, August 2000. Also to discuss with L M Pereira the managing of the European Network Compulog-Net, L M Pereira being a member of its Executive Council, and D Pearce the network's Coordinator.

Michael Schroeder , City U., London, UK, 5 days, 6-10 September 99. To discuss ongoing collaboration on implementation and applications of model-based diagnosis.

Pascal van Hentenryck , Leuven, Belgium, September, 3 days, common research on differential equations contraints.

Isabelle Debourges , Université d'Orléans, France, 1 week, June 1999. Isabelle Debourges, worked with Éric de la Clergerie in the paralellization of DyaLOG system. This system is currently being used by Vitor Rocio and Alexandre Agustini. So, this visit, in the framework of project RELING was intended for enabling the design of the Ph.D. programme of Isabelle Debourges.

Henri Prade , U. Toulouse, France, 1 week, October 1999. In this visit, within project RELING, work was done in the co-supervision of the Ph.D. thesis of João Moura Pires.

Manuel Vilares Ferro , U. Vigo, Spain, 4 days, 19-22 January 99. Setting up collaboration on logic program updates and the enrollment of Cabrero Souto in our AI MSc degree.

James Allen , Rochester University, USA, a week, May 12-19, 1999. Our interests on dialogue systems and the results obtained by both groups working at the Rochester University and the New University of Lisbon, together with our mutual interst on web applications was the starting point for preparing this visit. Prof Allen gave a talk on "Conversational Computers" on May 18, 1999.

Sylvie Guilloré , Université d'Orléans, France, 1 week, June 1999. This visit, in the framework of the RELING project, was done in order to deepen on-going work with Gael Dias.

Mike Dillinger and Anabela Barreiro Colasuonno , Logos, USA, April 16 and 19, 1999. Visit to CENTRIA and demos of the results obtained on automatic extraction of contiguous and non-contiguous multi-word lexical units, on automatic extraction of subcategorization frames for languages. Description of our work on parallel text alignement and translation equivalents automatic extraction. LOGOS is a company interested on some of the results we have obtained.

Wayne Redenbarger , Ohio State University, USA, one day, March 22, 1999. Exploration of future cooperation in the area of corpus linguistics.

Douglas Fisher , Universidade de Vanderbiet, USA, September 1999, collaboration in the HOC-TV project.

Berilhes Garcia , Universidade Federal do Espirito Santo, Vitoria, Brazil, 15 days (October 29 till November 13, 1999. Discusssion of Berilhes Ph.D. thesis first draft and continuation of collaborative work.

9 CENTRIA evolution graphics

CENTRIA projects funding/year

Year	Funding in K PTE
1997	33 127
1998	35 210
1999	31 349