CENTRIA
Centro de Inteligência Artificial da UNL

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2000 Report of Activities
2001 Planned Activities
2001 Budget

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April 2001

Contents

1 CENTRIA 2000 report of activities

The present report was unanimously approved by the Scientific Committee of CENTRIA in July 24, 2001. The plans approved in 1999 for 2000 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 per PhD holder. The global indicators in the tables in Section 9 show, with respect to 1999:

However, it has to be taken into account in the analysis of these results that:

- There was no activity in the Cognitive Sciences area, which has been decided to put on temporary hold till circumstances eventually permit its development, with the return of PhD students abroad. The fact is that there was no production nor activity reported in this area. Indeed, one of the presumed members in this area, Prof. José Rodrigues dos Santos, from Évora never officially entered the paperwork authorizing him to be a member of the centre. Second, Prof. Manuel Costa Leite, a member working in the area reported no activity nor publications. He asked to resign from the Centre and the Scientific Committee accepted his resignation.

- Three members of the centre in the soft computing area left for another centre which better serves their interests (Centro de Robótica Inteligente at Uninova). This has been compensated for by the hiring, in 2001, of 2 postdocs from abroad. Also a restructuring of the centre's areas was made, namely fusing the Soft Computing and the Constraints areas into one.

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

The 2000 budget was executed according to plan, including the programatic funding for equipment and library. The programatic funding for visitors was allocated, and announcements were posted for two visiting positions in 2001 in the Machine Learning and combined Machine Learning and Natural Language areas. 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.

Recall that the centre's Director had 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. The Director of CENTRIA who was elected as President the previous year, continued to function in this capacity.

The Advisory Committee was duly notified of last year's report but its members were not able to visit the centre in 2000 and express their written opinion.

The detailed rendition of each of the subareas' activities is to be found below. The plans for 2001, included, detail how they will develop.

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.

1.1 Subarea: Knowledge Representation and Reasoning, and Logic Programming

CENTRIA's "Knowledge Representation and Reasoning, and Logic Programming" area focused its activities in 2000 on the following main topics: the use of logic programs to model rational agents, dynamic logic programing and logic programs updates, residuated logic programs, abduction and preferences, coupling of belief revision and genetic algorithms, distributed tabling and revision systems, computational models and their implementation for a parallel and distributed logic programming language.

Dissemination of results continued to be an important concern. In this respect, 20 papers were published in this subarea in 2000: 3 in journals, 7 in proceedings commercially distributed, 10 in other proceedings. Of all publications 40% comprised international cooperation authorship, 10% national cooperation authorship, and 50% were internal to CENTRIA.

One member delivered a course in the "12th European Summer School in Logic, Language and Information", August 2000, Birmingham, UK, related on our research developed in this area, and titled "Semantics of Logic Programs and Non-monotonic Reasoning". The course slides are available online [72].

Two scientific conferences in this area, CL'2000 and JELIA'2000, where co-chaired by a member of CENTRIA, who is co-editor of the corresponding proceedings [1, 2].

International collaboration continued with the State University of California at Riverside, the State University of New York at Stone Brook, the University of Uppsala, University of Leipzig, University of Paris-VI, University of Paris-I, Federal University of Rio de Janeiro , and jointly with the Universities of Bologna and Ferrara. It focused on the issues of: updating (Riverside), tabling abduction, and psychiatric diagnosis (Stony Brook), rational agents (Uppsala), semantics of logic programs (Leipzig), constraint programming (Paris-VI and Paris-I), parallel and distributed logic programming (Rio de Janeiro), and learning (Bologna and Ferrara). A significant number of co-authored papers with researchers from these Universities were prepared and appeared in 2000.

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 PRAXIS project TARDE, coordinated by us, that begun in September 1999.

PRAXIS project MENTAL was completed, and its final report is available. During the last 3 years, most of the work in this area of CENTRIA was integrated in this large PRAXIS project (32KPTE). Besides several applications and implementations, 71 publications were produced within MENTAL: 6 edited proceedings, 9 journal papers, 2 book chapters, 2 published Summer School course notes, 25 papers in proceedings commercially published, and 27 papers in other proceedings.

In 2000 the work within project MENTAL concentrated in the philosophical scaffolding of the project, the modelling of rational agents, logic programs updates, residuated logic programs – a general logic programming framework encompassing generalized annotated programs, fuzzy logic programs, hybrid probabilistic logic programs and possibilistic logic programs – preferences in logic programming, multi-agent belief revision, and inductive learning. Additionally, implementation and applications were carried out. Work on the application of the developments in this area included applications to detection of alarm-correlation in cellular phone networks, to psychiatric diagnosis, to metaphorical mapping consistency, to software architectures reconfiguration, and to expert systems for filtering information in electrical networks.

Another PRAXIS project, ongoing during the whole year 2000, is project TARDE. The project aims at defining and exploring distributed tabling algorithms. In the first year of the project we have developed low message overhead algorithms for storing of tables and computation of answers in separated places. We have addressed the problem of detection of completed tables and provided a solution based on classical distributed algorithms without goal dependency propagation. It assumes a static declaration of the strongly connected components of the call graph. This enables simple and efficient distributed algorithms. We use as implementation platform the XSB-PVM Prolog.

It was recognized that a tabling threaded engine would be more appropriate to support efficiently the distributed computation model of the TARDE project. Thus, a thorough study was performed of the architectural changes to XSB necessary to implement this improved engine. Regarding the revision system, we proposed a new architecture which is more amenable to a distributed implementation than the older REVISE system. The ABDUAL system relies on the dual program transformation which introduces new rules for the negation of predicates, similar to Clark's completion transformation, and has been implemented as a Prolog meta-interpreter.

Starting November 2000 and ending in September 2001, a research and development project, NetBE, was signed with PARAREDE, an important IT company in Portugal. The project, funded in part by "Agência de Inovação", is concerned with advanced tools for B2B electronic commerce using logic programming and other technology developed by CENTRIA.

In September 1999 the two-year OAR project (Object-oriented And-or tree Rewriting systems) was started under the coordination of Salvador Abreu, which aims at defining a computational model and providing a prototype implementation for a parallel and distributed logic programming language, OAR. This language is based on contextual logic programming as well as and-or tree rewriting systems for the representation of computations. The OAR project involves two CENTRIA researchers: Salvador Abreu (principal researcher) and Lígia Ferreira (PhD student) 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).

The OAR project has been evolving according to plan and there is already a prototype implementation of Contextual Logic Programming over GNU Prolog, which was the subject of a visit by Salvador Abreu to INRIA and the University of Paris-I in August/September 2000. The model for implicit parallel execution of Logic Programs under a DSM architecture has been defined and is currently being implemented on an 8-node dual-processor (16-CPUs) Beowulf cluster acquired jointly with University of Évora. The Java constraint programming system underwent a complete re-write in order to make it more amenable to being parallelized in a similar environment. This work is partly described in [7, 46, 59, 16].

The SIIUE project, an applied research and development project funded by the Rectorate of the University of Évora, proposed in late 1999 was started in June 2000 under the coordination of Salvador Abreu. The goal of this project is to continue the specification and development of a University-wide logic-based information system for the management of academic and other information at the University of Évora. This project initially involves three CENTRIA members: Salvador Abreu (principal researchers), José Rodrigues dos Santos and Lígia Ferreira. This work is partly described in [17]. This project has spurred the submission of two related externally-funded projects involving CENTRIA researchers, both of which are currently under review.

To bridge the Centre's several areas continues to be a long term strategy, and in 2000 we continued the connections made with respect to learning techniques, 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: Natural Language

Intelligent Information Retrieval, Cross Language Information Retrieval and Machine Translation were the applications chosen for our research activities. It required the integration of language dependent competence (parsing), language independent competence (machine learning, text mining and information extraction) and techniques (symbolic, logic-based, neural-nets-based soft computing, statistics).

In 2000, we have addressed two complementary problems:

- **Text processing for automatic information extraction** In this area we have continued previous work on neural-networks-based Part-of-speech taggers generation, adapted to no matter the language and text genre, addressing the tagging of multi-word lexical units, where it makes no sense to disambiguate POS-tags for each word in compound terms. Example: "a partir de" is a prepositional locution and there is no need to tag each of its word constituents. This work has been used on unsupervised verb clustering according to the subcategorization frame each verb prefers. For this purpose Nuno Marques used loglinear modelling of a 43 million words corpus automatically POS-tagged. This gave rise to Nuno Marques Ph.D. thesis that was defended in January 2000. POS-tagged corpora was also used on robust parsing of text, including faultfinding and fault repairing of either text faults, or system faults, or faulty knowledge resources. This is the theme of the PhD thesis of Vitor Rocio that must defended prior to the end of 2001. This work also gave rise to a paper in the Journal Grammars that will appear in 2001. Our parsers do parse 250 words per second. In order to integrate into a

complex architecture the various fault-repairing parsers that have been built, a multi-agent architecture for adaptive parsing was designed. As a consequence, a partially parsed corpus has been obtained and was used for automatic thesaurus construction and for extraction of word selection restrictions. Pablo Gamallo, a post-doc that started to work with the natural language group in June 2000, mainly supervised this work on thesaurus construction. Work on extraction of contiguous and non-contiguous patterns from simple and annotated text (word patterns, character patterns, Part-of-speech tag patterns) continued. Multiword lexical units automatically extracted were used as features for unsupervised document clustering and for topic extraction from text clusters. This work on document clustering will be reported along 2001 and is the basis for the Ph.D. thesis by Joaquim Ferreira da Silva. The extraction of non-contiguous patterns is the focus of the Ph.D. thesis by Gael Dias that will be ready till the end of 2001. Non-contiguous character patterns extracted from bilingual parallel corpora were used for finding out possible character sequences that may be selected as alignment points, acting then as cognates. This work was recently presented to ACL-EACL'2001. Just using homograph words, numbers, punctuation signs there was a large work done and reported in internationally important conferences (ACL, ECAI, AMTA, PRICAI, etc.) on parallel text alignment statistically based and on translation equivalents extraction. The alignment we do is finer than sentence level. Each segment may have an average number of characters ranging from 8 for Spanish to 13 for English. More extended experiments will be performed for other languages. This is the focus of the Ph.D. thesis of António Ribeiro that we expect to be ready till the end of 2001.

- **Co-operative Information Retrieval Dialogues** Components of a co-operative dialogue system for interfacing legal information retrieval systems were developed mostly by Paulo Quaresma and Irene Rodrigues. Such a dialogue system is intended for helping users to define their own goals. For accomplishing this purpose user information requests are used for assessing user intentions. Knowledge about text content which is extracted using above mentioned methodologies, as well as domain rules represented in a knowledge base are also used for supporting the same purpose.

  Traditional dialogue systems must recognise their users' goals and plans. User intentions for achieving goals and for acting are represented and inferred by the system by using domain knowledge which includes a library of plans, and by reasoning in order to check if a plan is correct. The discourse structure of this kind of dialogues is complex. It has many kinds of segments (continuation, elaboration, repair, clarification, etc.) and it is built by inferring user intentions, taking into account clue words and using plans structure (task and dialogue plans).

  In the system we have developed each event (utterance) is represented by logic programming facts that are used for dynamically updating the system's previous model. Using this approach it is possible to represent new events as update logic programs and to attain new states. Moreover it is possible to reason about past events and to represent non-monotonic behaviour rules. Each utterance will trigger the inference process about user intentions taking into account his/her attitudes (beliefs and profile).

  The results of the inference of the user intentions are: a new set of user and system beliefs; a new set of user and system intentions (such as user intention of being informed about something); a new dialogue structure.

  The dialogue structure keeps the dialogue context allowing for the interpretation of user acts in its occurrence context. The dialogue structure constraint the interpretation of user intentions and is built as a result of the intention inference.

  Along the year 2000 were developed:

  - **A Logic Programming Agent for Controlling Distributed Web Dialogues.** The architecture for this Prolog based dialogue manager for a Web Information Retrieval system includes: an agent manager that receives all the user requests and keeps a

database with all the users' interrogation (dialogue) context; several process agents that, given a user request and the corresponding interrogation context, are able to answer him/her and to update his/her interrogation context; an agent monitor that informs the agent manager of the latest changes in the documents databases.

- **Automatic classification of case-law texts.** An automatic case law supervised classifier based on a neural Network was developed. The classifier receives as input a legal text and proposes a set of key words characterising it. These key words belong to a taxonomy of juridical concepts developed by the Portuguese Attorney General Office. This supervised approach is different from the one developed by Ferreira da Silva, mentioned above
- **Intelligent Clustering.** Another important aspect of the system developed is its ability to compute document clusters associating a keyword with each cluster. This ability allows the system to model world knowledge such as the granting of a pension for relevant services, or the refusal to grant it. The clustering and reclustering process proposed requires the classification of all documents using the set of keywords of the juridical thesaurus that was available.

In this area, one Ph.D. thesis was defended in March 2000, in Brazil, by Michael Móra, under the co-supervision of Gabriel Pereira Lopes and Rosa Viccari. Another Ph.D. thesis, by Berilhes Garcia, supervised by Gabriel Pereira Lopes, was submitted in September 2000 and will be defended in 2001.

Dissemination of obtained results was an important concern. As a consequence 28 papers were published: 4 papers in journals; 4 book chapters; 11 in very important conference proceedings published by Springer and similar publishers; 9 in less important conferences.

Praxis project PGR was completed and its final report will be available very soon. A co-operation project with CNRS- Marseille has finished. An European MLIS project on Machine Translation with SYSTRAN has started and a co-operation project with INRIA-Rocquencourt and University of Orleans has also been approved. This project aims at strengthening previously initiated co-operation in the framework of the RELING project. Project FUNDAÇÕES with Brazil has been approved for continuation.

The demo project launched with IGM (Instituto de Geologia e Minas), in order to demonstrate current capabilities for applying our Information Retrieval technology to areas different from law-case, such as reports on ore prospecting, was finished. The system developed helps users to discover the concepts and documents they were looking for, even when they know very little about the subject matter they are searching. The preliminary integration of the Geographic information system existing at IGM and the Information Retrieval system we have prepared for handling ore prospecting documents (http://coluna.di.fct.unl.pt/˜ igm) was accomplished

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

Collaboration with Brazilian universities was prospected in order to reinforce further previously activated small-scale co-operations. The identified areas and possible collaborations are: syntactic checking, with Universidade Federal de São Carlos (S. Paulo) and Microsoft-ITAUTEC; distant learning, with Universidade Federal do Espirito 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 and new collaborations have started: with Faculdade de Ciências Sociais e Humanas of Universidade Nova de Lisboa, for the Machine Translation Project and with Universidade de Aveiro, with the submission of various projects in the framework of ALFA programme. In Spain there is an ongoing effort for co-operation both on Machine Translation, information extraction from corpora and parsing.

By intensifying the co-operation with the Linguistics Centre of Universidade Nova de Lisboa, by participating in the same European project on Machine translation new steps were given in order to enable the launching of a Laboratory dedicated to Written Language Technologies and

multilingual and multimodal man-machine interfaces. Such a Laboratory will include specialists on Linguistics, Natural Language Processing, graphics processing, video indexing, machine learning and other co-related subject matters, namely software engineering and parallel and distributed architectures. Contacts with enterprises were also carried out.

Gabriel Pereira Lopes, Nuno Marques and Vitor Rocio organised a series of tutorials on "Extraction of Information from Text" in September 15-16, 2000. These tutorials culminated a week dedicated Machine Learning applied to Natural Language which included the 5th International Colloquium on Grammatical Inference (ICGI-2000) (September 11-13, 2000), chaired by Prof. Arlindo Oliveira from IST/UTL, the 2nd Learning Language in Logic Workshop (LLL 2000) (September 13-14, 2000) and the Fourth Workshop on Computational Natural Language Learning (CoNLL 2000) (September 14, 2000). The tutorials were taught by: Raymond Mooney (University of Texas at Austin), Walter Daelemans (from the Antwerp University, Belgium), Dunja Mladenic (from Carnegie Mellon University, U.S.A., and Jozef Stefan Institute, Slovenia), 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).

1.3 Subarea: Constraints

As planned, the research in the topic of Constraints during 2000 was based on the work of 4 Ph.D. students, as reported below.

The work on non linear constraints over the reals, including (parametric) differential equations (Jorge Cruz) has addressed the maintenance of global hull consistency in a network of constraints. This criterion of consistency was properly formalised and the algorithms that enforce it were extended to include local search. A number of local search algorithms were considered, the most promising seem to be those using the Newton Method. We adopted OpAC as the language to develop these solutions, and discussed them with by Frédéric Benhamou, who visited CENTRIA in January.

The work of Ludwig Krippahl has also progressed in improving the local search part for finding the 3-D structure of proteins from NMR data. This makes it possible to obtain feasible chemical structures, with correct angles between the atoms, but there are still some significant distance violations, that require further improvements in the algorithms. During the visit of Michael Trosset (William and Mary College, Va. USA) we discussed the possibility of using his methods from Computational Geometry from our approximate solutions, using only constraint propagation. The results were promising regarding the accuracy of the solutions, but a) the executions time are too high, and b) we do not know what happens in the presence of incomplete data, typical from NMR.

In the topic of correction of linear programs (Paula Amaral) we studied with Michael Trosset the possibility of integrating our algebraic approach based on the total least square methods with a non-linear minimisation problem that he had exploited earlier. Furthermore Paula has done a thorough research on additive corrections to the unfeasible model, postponing for next year the problem of a multiplicative corrections.

In the topic of digital circuits, Francisco Azevedo has exploited the modelling of diagnosis and optimisation problems with set constraints and implemented Cardinal, a set constraint solver that exploits actively the cardinality of sets. This solver, built on top of the Eclipse CLP system, has shown better performance than Conjunto, the original set solver built on the same platform. This has motivated a visit of Francisco to the IC Parc, where he discussed possibilities of future integration of Cardinal in the Eclipse libraries.

In addition to this research work, there were several projects submitted with mixed results. Project Proteins, that was focussed on the work of obtaining the spatial structure of proteins from NMR data was submitted in 2000 to the Fundação de Ciências e Tecnologia (FCT) and accepted. The project will exploit, focused, but not restricted to, this problem, the complementary nature of constraint programming, local search and optimisation methods and machine learning techniques. Another project that was submitted to the FCT with a team from INESC lead by João Marques Silva, focussed on a comparison of constraint programming and boolean satisfiability

(SAT) algorithms for solving a number of problems with digital circuits. This project was not approved, but we already agreed in reformulating it and submit it to another topic area (it had been submitted in the Electronic Engineering area).

Pedro Barahona visited the Pontifícia Universidade Católica (PUC), in Rio de Janeiro, Brazil, where he gave a seminar on constraint programming. Following this seminar, and the talks with Celso Ribeiro, a recognised expert in the topic of local search and meta-heuristics, we decided to submit a cooperation action between CENTRIA and the PUC to exploit the complementary nature of constraint programming and local search and meta-heuristics. This project is still under consideration by the science boards of the two countries (Portugal and Brazil).

1.4 Subarea: Soft Computing

As a consequence of the leaving of 3 PhDs from the Soft Computing subarea, an attenuation of the research work was expected, especially in the area autonomous agents and fuzzy systems. However, a continuity of part of this work was possible with the work of a remaining PhD student in the area of fuzzy clustering. Joint projects with the former member Fernando Moura-Pires of the Centre in the field of TV audience preferences analysis and application of learning algorithms to financial risk management also enabled a continuity of this work. As planned, the research work in the area of neural networks for temporal data mining has been continued and extended to other application domains, such as molecular genetics and classification of aerial photographs and high resolution satellite images in collaboration with the Department of Statistics of the University of Dortmund. As planned João Moura Pires finished and has presented his thesis on "Flexibility as Relaxation in Constraint Satisfaction" in the area of Fuzzy Constraints in which he presents a systematic study of structural properties of the relaxation space associated with a set of m fuzzy constraints; a logical interpretation of an arbitrary aggregation of fuzzy constraints; and the definition of fuzzy constraints interactions without an explicit use of an aggregation operator. It also includes a state of the art review of the application of local optimization techniques to constraint optimization. Some work in this direction was developed by starting the implementation of a tabu search integrated with case base-decision and fuzzy rule based controller techniques.

The work of the PhD student Susana Nascimento adressed Fuzzy c-Means (FCM) clustering techniques, that have been applied effectively in image processing, pattern recognition and fuzzy modeling. However, these techniques typically fail to explicitly describe how the fuzzy cluster structure relates to the process from which data had been generated. In the present research, we propose a framework for fuzzy clustering 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. From this generic approach, the following has to be stressed: 1) Some *a priori knowledge* of the data domain is assumed. 2) The clustering process (algorithm) takes into account the underlying model, and leads to a cluster structure which is reflected in the model. 3) The main focus of interest is not in clusters themselves but in the following aspects: a) model-based inferences to explanatory hypotheses about data; and b) data recovering from the cluster structure. Note that point 3) is an open point to be developed in the near future.

In the topic of neural networks and machine learning, work related to temporal data mining applied to distinct application areas has been developed. Hierarchical neural networks with unsupervised learning have been proposed to model and discover complex structures in multivariate time series. Therefore, an extension of the original algorithm was afforded, based on the combination of several approaches for temporal processing. These are: the introduction of several hierarchical levels in order to handle the complexity given by the large number of signal channels; a visualization of the network structures for exploratory tasks; and trajectories for a visualization of the temporal course. Since the main difficulty in handling hierachical neural networks lies in the finding of an adequate representation of the results of the lower-level networks, a codification was proposed that integrates the found structures using special visualisation techniques for clustering.

This work was also extended to other application domains, such as the analysis of TV audience preferences, financial risk management, molecular genetics and classification of aerial photographs

and high resolution satellite images.

The analysis of TV audience preferences was made within a PRAXIS research project in collaboration with Fernando Moura-Pires, a former researcher of the Centre, and Douglas Fisher from the Vanderbilt University, USA. The main project aim lies in using unsupervised methods for finding individuals inside the same group that have the most similar TV programming preferences, in other words, that will choose to watch the same TV channel. Therefore, during this year a prototype was implemented that performes an hierachical agglomerative clustering of objects (individuals).

In the topic of time series analysis and mining for finance risk management a joint project, named TSAM (http://ssdi.di.fct.unl.pt/˜ gg/TSAM/TSAM.html), with Fernando Moura-Pires, University of Évora, the ML-group of Pavel Brazdil, University of Porto, João Matos, Faculty of Economy, New University of Lisbon and Gerhard Arminger, Bergische University Wuppertal, Germany was started this year. The project aims to apply, adapt and compare a wide-range of techniques from the fields of artificial intelligence, econometrics, statistics and information theory to financial risk management, and in particular to portfolio selection. Advanced statistical models that accurately model financial returns and stochastic volatilities will be studied and compared to traditional econometric time series models. Furthermore, different methods and algorithms for the analysis and prediction of financial time series will be studied and compared. Our aim will be to discover inherent structures and qualitative relationships in financial multivariate time series and generate an intelligible and characterizing description of the discovered patterns. For this, modern AI-based and statistical methods will be used and compared. An improvement of the quality of prediction is expected.

In collaboration with Wolfgang Urfer of the Department of Statistics, University of Dortmund, Germany two distinct collaborations have been started. In the first one, a combination of methods from statistics with neural networks in bioinformatics is studied. The most important contribution of statistics has been the development of strategies for extracting information from DNA and protein sequence databases by sequence comparison, characterization and classification. As complex patterns are searched for and a hierarchical segmentation of the problem is needed, hierarchical unsupervised neural networks are studied in this context. Since we also have a sequential component, in addition to the hierarchical component, an enhancement of the original learning algorithms in the field of neural networks combined with statistical methods, such as Hidden Markov Models, is expected.

The second collaboration is focussed on the comparison of statiscal clustering methods with unsupervised neural networks. Here, the progress of erosion, land degradation and desertification has been studied. The availability of aerial photographs and high resolution satellite images opens up possibilities for the analyst to perform a detailed investigation on such phenomena. The information gathered within such images are far too much to handle, therefore statistical tools are needed to reduce the information to a sufficient quantity. Clustering methods, such as the new maximum linkage and a winner-takes-all-network have been applied to these data and their performance with regard to their clustering capabilities was studied. These methods have been used to find an appropriate set of initial centroids for a classification of such images.

In 2000 Gabriela Guimarães visited the Department of Statistics, University of Dortmund, Germany several times, in order to strengthen the relations with statistical research groups that are of main importance for the machine learning area. This resulted in the collaborations mentioned above. She also was invited by the Department of Statistics to give a series of post-graduate courses in neural networks and to give a lecture in a yearly organised colloquium for graduate students on applied statistics. In addition, further collaborations with the Department of Statistics were made with Walter Kraemer, who is working in the field of econometrics. During one month, a PhD student of Fernando Moura-Pires, member of the TSAM project, visited the Department of Statistics.

1.5 Subarea: Cognitive Science

As explained in the introduction there is no activity to report.

2 CENTRIA 2001 planned activities

Below each subarea provides in detail its plans for 2001.

2.1 Subarea: Knowledge Representation and Reasoning, and Logic Programming

Our research in 2001 will concentrate on the following main topics:

- logic programming based agent architectures;
- logic programs updates, and update language;
- applications of update languages to legal reasoning and software specification;
- studies on abduction in the context of updates;
- residuated logic programs;
- distributed implementation of logic programming with tabling;
- 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 the ISCO language (a prolog variant with database access features) as the main device for constructing information-intensive web sites.

Some of this work will be carried out in the context of the ongoing projects: PRAXIS OAR - Object-oriented And-Or tree rewriting systems; PRAXIS TARDE - Tabulation and revision in a distributed Prolog environment; AdI/PARAREDE NetBE - Electronic Commerce and Web Banking; SIIUE - Logic-based information system for the management of academic and other information.

Progress on the OAR project should result in visits to INRIA as well as a visit by Daniel Diaz (U. Paris I). A new design and an efficient implementation will be developed for Contextual Logic Programming, using GNU Prolog as the starting point. Also on the context of this project the newly-aquired (jointly with Universidade de Évora) 16-node mixed distributed/shared-memory multiprocessor should host the first implementation of the OAR language. Also within the scope of this project, the AJACS constraint programming toolkit for Java shall be implemented using a distributed-memory model. A JNI interface is also being built for GNU Prolog.

Within project TARDE, work should be done according to the project's plans. A distributed implementation of logic programming with tabling is scheduled for the end of 2001. Also foreseen for 2001, within the context of TARDE, is the implementation of the ABDUAL method for abduction.

The application project AdI/PARAREDE NetBE will continue till September 2001. Logic programming tools for supporting the software development of NetBE Application Server components are expected to be concluded.

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 reach a mature implementation, based on GNU Prolog. Multiple new back-ends for ISCO should be implemented, including the generic ODBC back-end, an LDAP back-end and an SNMP back-end.

Three new projects were submitted to PRAXIS in the beginning of 2001, that are planned to start by the end of this year: one on update language and applications; one on logic-based computational models for distributed shared-memory multiprocessor architectures; another on the development of logic programming tools for information systems.

A 3 weeks visit, in January, to the University of California at Riverside was planned by Luís Moniz Pereira and José Alferes, to continue their collaboration with the group of Prof. Teodor Przymusinski on the subject of logic programming update languages.

Collaborations with the following group are planned to continue: State University of New York at Stony Brook, the University of Maryland, Universities of Bologna and Ferrara, the University of Linköping. Collaboration with the University of Pisa will be strengthen in 2001 and 2002, and will take place within the context of the bilateral collaboration project "Rational and Reactive Agents" (funded by ICCTI/CNR).

We will chair the "International Joint Conference on Declarative Programming", AGP'01 in September, Évora, and the "Workshop on Logic Programming for Artificial Intelligence and Information Systems" in December, at Porto. This last workshop is included in the 10th Portuguese AI Conference, EPIA'01. The edition of two special issues of journals is also planned: Logics for AI, extended selected papers from JELIA'00, Special Issue Studia Logica eds: Brewka, Guzman, Ociega, Pereira; Change in Knowledge Bases, Special Issue of TPLP, eds: Pereira and Przymusinki.

Regarding supervision of PhD Thesis, one student (João Leite) is planned to finish his thesis by the end of 2001, and two new PhD students will start their work: José Ferreira de Castro, to be supervised by José Alferes, and to work in the subjects of submitted project FLUX; João Alcântara, from Brazil, to be co-supervised by Carlos Damásio and Luís Moniz Pereira, and to work on abduction and paraconsistency.

Two master courses will be taught: "Knowledge Representation and Computational Reasoning", for the Master on Informatics Engenieering, FCT/UNL; "Computational Reasoning" for the Master on Philosophy of Language and Cognitive Sciences, FSCH/UNL. The teaching of this latter course may allow for a closer collaboration with the group Philosophy of Language of the Faculty of Human and Social Sciences (FCSH).

2.2 Subarea: Natural Language

Investment in post-graduation will be continued, namely in the Masters Course on Informatics Engineering (with the discipline of Information Extraction from Text), and in the Masters Course of Pontificia Universidade Católica do Rio Grande do Sul, Porto Alegre, Brazil.

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 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 2001, 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 2001, seven Ph.D. thesis will be finished. At least four of them will be discussed in 2001.

During 2001 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 multi-lingual 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, to topic extraction, and information retrieval.

- symbolic and statistical methods for pragmatic interpretation of texts: anaphora resolution, pp-attachement, adjectives attachement, relative clauses attachement;

- Dialogue handling: Results obtained by Paulo Quaresma, Irene Rodrigues, Michael Móra, and Berilhes Garcia in the framework of their Ph.D. theses may be applied to Intelligent (Cross Language) Information Retrieval (CLIR). Nuno Marques will be using results from automatic extraction of information from documents, and from supervised and unsupervised classification of documents, for improving a chatroom teaching assistant in a distance learning framework;

- 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. We will specially concentrate ourselves on the pairs PT-EN, EN-PT and PT-FR.

- Moreover, in the Machine Translation area, we will study carefully the SYSTRAN translation system in order to be able to use its intricacies for achieving a correct parsing of Portuguese text in at least four legislative areas (customs, water resources, social policy and economy and finance. We will also concentrate on the transfer and synthesis in English and French. Apart from that we will also concentare on English to Portuguese transfer and Portuguese synthesis. Apart from a correct use of SYSTRAN MT system potentialities, we will work on the the integration of the technology developed in the GLINT group since its creation, into the SYSTRAN machine translation system as there is plenty of place for innovative enhancements both in the automatic creation of terminological translation equivalents and on the creation of tools for helping the validation of automatically obtained translations.

- 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. In this area we will integrate as much as we can from the results already obtained on automatic thesauri construction, in multi-lingual translation equivalents construction, and in unsupervised classification of texts for enabling new forms of intelligent interaction with users.

- Start a strategic partnership with Portuguese Government, by proposing the launching of an Associated Laboratory, in order to enable web-based access, management and translation 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 alignement techniques already used on parallel text alignement. This requires the association with a strong group on speech recognition and synthesis.

2.2.1 Subarea: Natural Language: Planned visitors

There will be the visit of Professors: Marco Gonzalez (Pontificia Universidade do Rio Grande do Sul, Porto Alegre, Brazil, in December); Eric de la Clergerie (INRIA-Rocquencourt, France, July), Renata Vieira (UNISINOS, Rio Grande do Sul, Brazil, in July).

2.2.2 Subarea: Natural Language: Planned visits

Apart from presentations of papers in international conferences we are planning the following visits:

- Gabriel Pereira Lopes will stay in Luxembourg, at SYSTRAN, during four months from April till July, 2001, to work in the framework of the European MLIS project on Machine Translation. Mário Alves will accompany him from April till May. Later two linguists working in the same project will stay in Luxembourg from June till July, 2001.
- In August 2001, Paulo Quaresma will be at Pontificia Universidade Católica do Rio Grande do Sul, Brazil, for working with Michael Móra and for teaching a joint course on agents' architectures.
- Gabriel Pereira Lopes and Vitor Rocio will visit INRIA-Rocquencourt in order to work with Eric de la Clergerie in September 2001.
- Gabriel Pereira Lopes will visit the Federal University of Espirito Santo, Vitória, Brazil in November 2001 for working with two Ph.D students he is supervising and for working on Distance Learning, by using various methods (statiscally based and softcomputing based) for classifying questions and exercises made by the students, giving another perspective on long distance teaching and learning evaluation methodologies. He will also visit Pontificia Universidade Católica do Rio Grande do Sul, Brazil, mostly for supporting various masters' students and Ph.D. students, for teaching and evaluating master thesis. Contacts with local industry in the area of Information Technologies will be made.

2.3 Subarea: Soft Computing and Constraints

The area of Constraints has been merged with the Soft Computing area, due to their affinities and strategic and organisational aims of the Centre. Consequently, plans for 2001 will be made jointly for both subareas.

In 2001 research on the topic of constraints will still be focussed on the work of the Ph.D. students, but it will hopefully proceed in a more integrated way, not only between themselves but also exploiting research links with other areas of CENTRIA.

The work on the structure of proteins will be included in project Proteins, where the constraint processing component will be integrated with a local optimisation techniques and also with some components of machine learning. This machine learning component is sought in at least two parts: a) to learn adequate heuristics to efficiently enumerate the domains in the constraint solving part, so that the initial solution passed to the local search is as accurate as possible; b) to learn what are the most likely distance constraints which might be wrongly specified (an error that often occurs in the interpretation of NMR data). For this machine learning component, we have already established a collaboration of Thomas Dietterich (Oregon State University), that will visit CENTRIA this year. We also plan to start collaboration with our colleague in CENTRIA that has a special interest in Machine Learning (Gabriela Guimarães).

Both Ludwig Krippahl and Jorge Cruz are currently working on local optimisation, although with different goals in mind. Whereas Ludwig is using local optimisation to improve on solutions provided by constraint processing, Jorge is using local optimisation to improve constraint propagation in non linear constraints. Despite these differences there are common issues to explore in this integration of local search and constraint processing that will hopefully be highlighted during this year. The complementary nature of local search and constraint processing will also be hopefully exploited in collaboration with the team lead by Celso Ribeiro (Pontifícia Universidade Católica , Rio de Janeiro) if the joint action that was submitted is funded.

The work of Jorge Cruz with optimisation also has a certain commonality with the work of Paula Amaral, namely by both using the single value decomposition of matrices. This link will be further explored this year, in addition to the research in corrective multiplicative models for unfeasible linear constraint problems.

Francisco Azevedo will proceed his work on constraint processing applied to digital circuits, namely to address some optimisation problems (e.g. generating the least number of specified

inputs to detect faulty gates). This will involve the processing of constraints both for set domains and multi-valued logics. We plan to study and compare the efficiency of the modelling of these problems in this type of constraints and the alternative of using boolean models (to which SAT solvers are applied). For this purpose we plan to reformulate and resubmit to Fundação de Ciências e Tecnologia a joint project with the INESC team lead by João Marques Silva.

The modeling of sets has also been found useful to our colleagues in CENTRIA that work in the area of Knowledge Representation, to formalise more general frameworks for logic programming and use it in modelling abductive reasoning. We plan to do some joint work in this area, namely to compare the alternative methods to solve a number of abductive problems.

In 2001 research on the topic of neural networks and machine learning will be continued within the four main projects and collaborations, namely the analysis of TV audience preferences, time series analysis and mining for financial risk management (TSAM), molecular genetics and classification of aerial photographs and high resolution satellite images.

In the TV audience preferences project we will have further support from a MSc. student. Here, several algorithms for hierachical agglomerative clustering of objects (individuals) will be studied and applied to the data. We expect to develop a system that handles a very large number of time series, in this case 1600, representing each individual, and enabling the identification of distinct behaviour profiles. This approach is also of extreme relevance for other applications, for instance in the field of customer relationship management, where a large number of time series are analysed.

In the TSAM project we plan to perform a case study. We will choose an appropriate set of stocks for our portofolio selection. Some work was already done in 2000 during the visit of the PhD student at the Department of Statistics, University of Dortmund, and by the group of Pavel Brazdil, University of Porto.

A continuation of the work with Wolfgang Urfer in the area of molecular genetics and classification of aerial photographs and high resolution satellite images is planned in collaboration with his PhD students, since he will spend his sabatical this year in Lisbon. A visit to the Centre is also planned. We also planned some collaboration in this area with the constraints subgroup.

In the area of Fuzzy c-Means (FCM) clustering techniques, the research work will be consolidated with a more extensive experimental study and part of the Ph.D. dissertation will be written.

During 2001, 3 conferences/workshops in the area of AI will be organised. These are: AIME-2001, The Eigth European Conference on Artificial Intelligence in Medicine, July, 1-3 2001, Cascais, Portugal (http://centria.di.fct.unl.pt/conferences/aime01/); IDA 2001, The Fourth International Symposium on Intelligent Data Analysis, September 13-15, 200, Cascais/Lisbon, Portugal (http://centria.di.fct.unl.pt/ida01/); and EKDB-2001, the 2nd Workshop on Extraction of Knowledge from Data Bases, December 2001, Porto, Portugal, associated with the EPIA-2001.

2.4 Subarea: Cognitive Science

As explained in the introduction there no plans to report. The area is on indefinite hold.

3 Base Funding for 2001

All values in K PTE.

Central Funding (Managed by the Board)	3 600	(25% of total)
Seminars	200	
Advisory Committee	800	
Services	800	
Reserve Funds	1 600	
Other management costs	200	
Assigned individual management by PhD' s	9 307	(75% of total)
Travel	4 000	
Equipment	6 947	
TOTAL	14 547	(Amount awarded by FCT/MCT)

Breakdown:

Scholarships and technical stuff	800	Services
Current	5 000	Travels, advisory committee, and seminars
Consumables	200	Other management costs
Reserve Fund	1 600	
Capital	6 947	Equipment
TOTAL	14 547	(Amount awarded by FCT/MCT)

4 List of ongoing projects in 2000

Name	MENTAL - An architecture for mental agents
Status	Finished
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	71 publication during the 3 years of the project, plus implementation platform and applications. Final report available from PRAXIS.

Name	CompulogNet - Network of Excellence in Computational Logic
Status	Finished
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	Finished
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	2 publications, and 1 visit in 2000.

Name	OAR – Object-Oriented And-Or Tree Rewriting Systems
Status	Ongoing
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	4 publications, 2 prototypes and 1 visit in 2000.

Name	SIIUE
Status	Ongoing
Funding Institution	Universidade de Évora
Principal researcher	Salvador Pinto Abreu
Participants	Ligia Ferreira, Joaquim Godinho, 2 graduate students, 4 undergraduate students
Description	Design and implementation of a logic-based information system applied to different sorts of information pertaining to an academic institution, in particular to Universide de Évora.
Results	1 publication and 1 prototype in 2000.

Name	TARDE - Tabulation And Revision in a Distributed Prolog Environment
Status	Ongoing.
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	3 papers during 2000, and several implementations.

Name	NetBE
Status	Ongoing.
Funding Institution	PARAREDE and Agência de Inovação
Principal researcher	Luís Moniz Pereira
Participants	Luís Moniz Pereira and Carlos Damásio
Description	Starting November 2000 and ending in September 2001, a research and development project, NetBE, was signed with PARAREDE, an important IT company in Portugal. The project, funded in part by "Agência de Inovação", is concerned with advanced tools for B2B electronic commerce using logic programming and other technology developed by CENTRIA.
Results	Some of the tools have been developed already.

Name	TRADAUT-PT — Automatic Translation System from and into Portuguese for public administration
Status	Started December 22, 2000
Funding Institution	European Commission and Fundação para a Ci%ncia e Tecnologia
Principal researcher	Gabriel Pereira Lopes
Participants	CENTRIA/DI/FCT/UNL, CLUNL, SYSTRAN, FCT/MCT and Instituto Cam
Description	Development of a quality translation by the SYSTRAN system for the pairs of languages Portuguese-English, English-Portuguese, and French-Portuguese.
Results	In 2000, very little work was 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 a Data Base kind of application that may be queried in Portuguese and French; taking into account context and discourse levels.
Results	In 2000, the adaptation of the ILLICO kernel to Portuguese was completed.

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 2000, work followed three complementary directions. 1) Automatic extraction of thesaurus from partially parsed PGR corpus. The results of this effort were not yet inserted in the search engine used in this project. 2) Supervised and unsupervised classification of documents of this collection of opinions. The first method used a neural network based approach and the key words used in those documents. The unsupervised classification used automatically extracted multi-word lexical units and statistical methods. Both must still be incorporated in the search engine used. 3) Statistically based parallel text alignment and translation equivalents extraction from parallel corpora continued. However it is still required a large effort in order to enable access to the opinions of the Portuguese General Attorney, using any of the European Community languages. Work in the framework of project TRADAUT-PT will provide a large basis for making this possible, at least for English and French speaking people. # 28 publications and a demo, together with annual report, are available at: http://coluna.di.fct.unl.pt/p̃grd. The final report is not yet available.

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 and JUSTIÇA (PT). Additional co-operation will exist on training master's and Ph.D. students.
Results	In 2000, a course was taught by Gabriel Pereira Lopes in cooperation with Nuno Marques in the master's programme of Pontifícia Universidade Católica do Rio Grande do Sul, at Porto Alegre, Brazil, on automatic extraction of information from large corpora. A Ph.D thesis by Michael Móra, co-supervised by Gabriel Pereira Lopes was defended in March 2000. One publication was produced.

Name	IGM — 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

Name	ORLISINROC — ORLeães - Lisboa -Inria ROCquencourt
Status	Approved
Funding Institution	ICCTI and French Embassy
Principal researcher	José Gabriel Pereira Lopes
Participants	CENTRIA, University of Orleans (FR) and INRIA-Rocquencourt (FR)
Description	development of a co-operation among the Portuguese and French teams in the area of Language Engeneering. This co-operation will be based on the development of tools, programming platforms and systems with diversified applications in Human language Technologies.
Results	In the framework of this co-operation a paper was already produced and will appear in 2001 in the journal "grammars".

Name	PROTEIN - Improving Constraint Programming to Predict Protein Structure
Status	Ongoing
Funding Institution	PRAXIS.XXI
Principal researcher	Pedro Barahona
Participants	CENTRIA/UNL
Description	The project aims at developing advanced computing techniques, focussing in constraint programming, and to show how their integration with other techniques such as automated learning and meta-heuristics optimisation, can be used to solve a very important problem: the determination of protein structure from Nuclear Magnetic Resonance (NMR) spectroscopy.
Results	Just started. First results in 2001.

Name	Heuristic Optimisation of Clusterings: Case study of TV audience preferences HOC-TV
Status	Ongoing.
Funding Institution	PRAXIS
Principal researcher	Fernando Moura-Pires
Participants	CENTRIA/UNL and UE
Description	The HOC-TV project intends to apply heuristic optimisation techniques in order to find the best clustering of TV audience preferences: Given raw data about past programming grids and viewers' program preferences, data mining (or KDD) methods are applied to identify useful and understandable features. These features are then used to form groups (clusters) in such a way that the individuals inside the same group have the most similar TV programming preferences, in other words, will choose to watch the same TV channel. Clustering algorithms are used to obtain partitions of the TV preferences..
Results	2 papers during 2000, and implementation of a prototype.

Name	Time Series Analysis and Mining for Financial Risk Management - TSAM
Status	Ongoing.
Funding Institution	PRAXIS
Principal researcher	Fernando Moura-Pires
Participants	CENTRIA/UNL, UE, UP, Bergische U. Wuppertal
Description	The project aims to apply, adapt and compare a wide-range of techniques from the fields of artificial intelligence, econometrics, statistics and information theory to financial risk management, and in particular to portfolio selection. Advanced statistical models that accurately model financial returns and stochastic volatilities will be studied and compared to traditional econometric time series models. Furthermore, different methods and algorithms for the analysis and prediction of financial time series will be studied and compared. Our aim will be to discover inherent structures and qualitative relationships in financial multivariate time series and generate an intelligible and characterizing description of the discovered patterns. For this modern AI-based and statistical methods will be used and compared. An improvement of the quality of prediction is expected.

5 List of M.Sc. and Ph.D. students and topics in 2000

5.1 M.Sc. Students

Name	José Ferreira de Castro
Degree	M.Sc.
Supervisor	Luís Moniz Pereira
Topic	Verificação abdutiva de um sistema de diagnóstico baseado em regras
Start date	October 1998
Finish date	December 2000

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	April 2000
Finish date	April 2001 (Expected)

Name	Silvia Pinheiro Martins
Degree	M.Sc. (Economia e Gestão de Ciência e Tecnologia, ISEG)
Supervisor	Luís Moniz Pereira
Topic	A ligação Universidade/Indústria e a dimensão económica das actividades de C& T
Start date	October 1999
Finish date	completed October 2000 (awaits exam)

Name	Tiago Antão
Degree	M.Sc.
Supervisor	Joaquim Nunes Aparício
Topic	Optimização em Bases de Dados
Start date	December 2000
Finish date	March 2002 (expected)

Name	Vitor Nogueira
Degree	M.Sc.
Supervisor	Carlos Damásio
Topic	Negação em Lógica Transacional
Start date	October 1998
Finish date	February 2001

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 2001 (expected)

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 2001 (expected)

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	Awaits exam

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

Name	Iara de Almeida
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	2002 (Expected)

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

Name	Rui Ribeiro
Degree	Ph.D.
Supervisor	Gabriel Pereira Lopes
Topic	Automatic Thesaurus construction, design of thesauri and use in Information retrieval systems
Start date	2000
Finish date	2004 (Expected)

Degree	Ph.D.
Name	Jorge Cruz
Supervisor	Pedro Barahona
Topic	Non-linear Constraints over Continuous Domains Including Differential Equations
Start date	October 1997
Finish date	September 2001 (expected)

Degree	Ph.D.
Name	Francisco Azevedo
Supervisor	Pedro Barahona
Topic	Constraint Solving and Optimisation with various logics and its use to digital circuits problems
Start date	October 1998
Finish date	September 2001 (expected)

Degree	Ph.D.
Name	Ludwig Krippahl
Supervisor	Pedro Barahona (co-supervisor)
Topic	Spatial Constraint Solving and its Application in Protein Structure Determination
Start date	October 1999
Finish date	September 2002 (expected)

Degree	Ph.D.
Name	Paula Amaral
Supervisor	Pedro Barahona
Topic	Optimal Perturbations to Unfeasible Sets of Linear Constraints to turn them Feasible
Start date	October 1999
Finish date	September 2002 (expected)

Degree	Ph.D.
Name	João Paulo Santos
Supervisor	Joaquim Nunes Aparício
Topic	Relational DataBases
Start date	March 2000
Finish date	December 2003 (expected)

Degree	Ph.D.
Name	Susana Nascimento
Supervisor	Fernando Moura Pires and Boris Mirkin
Contact element at CENTRIA	Luís Moniz Pereira
Topic	Fuzzy Clustering
Start date	October 1995
Finish date	October 2001 (expected)

Degree	Ph.D.
Name	Jorge Simão
Supervisor	Luís Moniz Pereira
Topic	Modeling and simulation of the evolution of cooperative behaviour in humans
Start date	March 1999
Finish date	March 2002 (expected)

6 Publications

6.1 Edited books

[1] M. O. Aciego, I. P. de Guzmán, G. Brewka, and L. M. Pereira. *Logics in Artificial Intelligence, Procs. of JELIA'00 European Workshop*. LNAI 1919. Springer–Verlag, Málaga, Spain, September-October 2000.

[2] J. Lloyd, V. Dahl, U. Furbach, M. Kerber, K. Lau, C. Palamidessi, L. M. Pereira, Y. Sagiv, and P. J. Stuckey (eds.). *Computational Logic - CL 2000, Procs. of First International Conference on Computational Logic (CL 2000)*. LNAI 1861. Springer–Verlag, London, UK, July 2000.

6.2 In International Journals

[3] J. J. Alferes, J. A. Leite, L. M. Pereira, H. Przymusinska, and T. C. Przymusinski. Dynamic updates of non-monotonic knowledge bases. *The Journal of Logic Programming*, 45(1-3):43–70, September/October 2000.

[4] P. Amaral and P. Barahona. About infeasibility in the constraints of a linear model. *Ricerca Operativa*, 29(92), 2000.

[5] Gabriel Lopes António Ribeiro and João Mexia. Extracting portuguese-spanish word translations from aligned parallel texts. *Sociedad Española para el Procesamiento del Lenguaje Natural*, 24:73–80, 2000. Special issue for the XVI Conference of the Spanish Society for Natural Language Processing (SEPLN 2000), Vigo, Spain, 2000 September 26–28.

[6] 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. *Traitement Automatique des Langues*, 41(2):447–473, 2000.

[7] Lígia Ferreira and Salvador Pinto Abreu. A CLP Framework in Java. *Elsevier Electronic Notes in Theoretical Computer Science*, 30(issue 3), 2000.

[8] Pablo Gamallo. Bases léxicas organizadas mediante un sistema de herencia mereológica. *Procesamiento del Lenguaje Natural*, 24:65–72, 2000. Special issue for the XVI Conference of the Spanish Society for Natural Language Processing (SEPLN 2000), Vigo, Spain, 2000 September 26–28.

[9] G. Guimaraes. Temporal knowledge discovery with self organizing neural networks. *The International Journal of Computers, Systems and Signals (IJCSS)*, Part I of the Special issue (Guest Editor: A. Engelbrecht): Knowledge Discovery from Structured and Unstructured Data(1):5–16, December 2000.

[10] E. Lamma, F. Riguzzi, and L. M. Pereira. Strategies in combined learning via logic programs. *Machine Learning*, 38(1/2):63–87, 2000.

[11] Paulo Quaresma and Irene Pimenta Rodrigues. Automatic classification and intelligent clustering for wwweb information retrieval systems. *Journal of Information Law and Technology (JILT)*, 2, 2000. http://elj.warwick.ac.uk/jilt/00-2/ – Extended and revised version of the BILETA'2000 paper.

6.3 Book chapters

[12] Gael Dias, Špela Vintar, Sylvie Guilloré, and J.Gabriel Pereira Lopes. Identifying and integrating terminologically relevant multiword units in the ijs-elan slovene-english parallel corpus. In Paola Monachesi, editor, *Computational Linguistics in the Netherlands 1999: selected papers from the Tenth CLIN Meeting*. Rodopi, Amsterdam-Atlanta, GA 2000, 2000. Electronic version: http://www-uilots.let.uu.nl/publications/clin1999/papers.html.

[13] Nuno M. C. Marques, J. Gabriel Pereira Lopes, and C. A. Coelho. Mining subcategorization information by using multiple feature loglinear models. In Paola Monachesi, editor, *Computational Linguistics in the Netherlands 1999: selected papers from the Tenth CLIN Meeting*. Rodopi, Amsterdam-Atlanta, GA 2000, 2000. Electronic version: http://www-uilots.let.uu.nl/publications/clin1999/papers.html.

[14] J. Moura Pires, F. Moura Pires, and R. A. Ribeiro. Why leximin FCSPs are so hard for local search. In L. Zadeh B. Bouchon-Meunier, R. Yager, editor, *Uncertainty in Intelligent and Information Systems*, volume 30 of *Advances in Fuzzy Systems- Applications and Theory*, pages 185–196. World Scientific, 2000.

[15] Paulo Quaresma and Irene Pimenta Rodrigues. Construire le contexte d'une interface web pour des bases de donnés juridiques. In D. Bourcier, P. Hassett, and C. Roquilly, editors, *Droit et Intelligence Artificielle*, Collection Droit et Technologies, pages 46–58. Editions Romillat, Paris, France, 2000.

6.4 In Proceedings of International Conferences

[16] Salvador Abreu. Towards the OAR Language and Computational Model. In *CL'2000 Workshop on Parallelism and Implementation Technologies for (Constraint) Logic Programming Languages*, July 2000.

[17] Salvador Pinto Abreu. A Logic-based Information System. In Enrico Pontelli and Vitor Santos-Costa, editors, *2nd International Workshop on Practical Aspects of Declarative Languages (PADL'2000)*, volume 1753 of *Lecture Notes in Computer Science*, pages 141–153, Boston, MA, USA, January 2000. Springer-Verlag.

[18] J. J. Alferes, H. Herre, and L. M. Pereira. Partial models of extended generalized logic programs. In J. Lloyd et al., editor, *Procs. of First International Conference on Computational Logic (CL 2000)*, volume 1861 of *LNAI*, pages 149–163. Springer, 2000.

[19] J. J. Alferes, J. A. Leite, L. M. Pereira, and P. Quaresma. Planning as abductive updating. In D. Kitchin, editor, *Procs. of the AISB'00 Symposium on AI Planning and Intelligent Agents*, pages 1–8. AISB, 2000.

[20] J. J. Alferes and L. M. Pereira. Updates plus preferences. In M. O. Aciego, I. P. de Guzman, G. Brewka, and L. M. Pereira, editors, *Logics in AI, Procs. of JELIA'00*, volume 1919 of *LNAI*, pages 345–350. Springer, 2000.

[21] J. J. Alferes, L. M. Pereira, H. Przymusinska, T. C. Przymusinski, and P. Quaresma. Dynamic knowledge representation and its applications. In S. Cerri and D. Dochev, editors, *Procs. of the 9th International Conference on Artificial Intelligence - Methodology, Systems, Applications (AIMSA'00)*, volume 1904 of *LNAI*, pages 1–10. Springer, 2000.

[22] J. J. Alferes, L. M. Pereira, H. Przymusinska, T. C. Przymusinski, and P. Quaresma. An exercise with dynamic logic programming. In L. Garcia and M. Chiara Meo, editors, *Procs of the APPIA-GULP-PRODE'00 Joint Conference on Declarative Programming (AGP'00)*, 2000.

[23] Gabriel Lopes António Ribeiro and João Mexia. Aligning portuguese and chinese parallel texts using confidence bands. In Riichiro Mizoguchi and John Slaney, editors, *PRICAI 2000 Topics in Artificial Intelligence - Proceedings of the Sixth Pacific Rim International Conference on Artificial Intelligence (PRICAI 2000). Melbourne, Australia, 2000 August 28-September 1. Proceedings*, volume 1886, pages 627–637, Berlin, Germany, 2000. Springer-Verlag.

[24] Gabriel Lopes António Ribeiro and João Mexia. Extracting equivalents from aligned parallel texts – comparison of measures of similarity. In Maria Carolina Monard and Jaime Simão

Sichman, editors, *Advances in Artificial Intelligence: International Joint Conference 7th Ibero-American Conference on Artificial Intelligence and 15th Brazilian Symposium on Artificial Intelligence (IBERAMIA-SBIA 2000), Atibaia, SP, Brazil, 2000 November 19–22. Proceedings*, volume 1952 of *Lecture Notes in Artificial Intelligence*, pages 339–349, Berlin, Germany, 2000. Springer-Verlag.

[25] Gabriel Lopes António Ribeiro and João Mexia. Linear regression based alignment of parallel texts using homograph words. In Werner Horn, editor, *ECAI 2000: Proceedings of the 14th European Conference on Artificial Intelligence*, volume 54, pages 446–450, Amsterdam, The Netherlands, 2000. IOS Press. Berlin, Germany, 2000 August 20-25.

[26] Gabriel Lopes António Ribeiro and João Mexia. A self-learning method of parallel texts alignment. In John White, editor, *Envisioning Machine Translation in the Information Future - Proceedings of the 4th Conference of the Association for Machine Translation in the Americas, AMTA 2000. Cuernavaca, Mexico, 2000 October 10-14. Proceedings*, volume 1934 of *Lecture Notes in Artificial Intelligence*, pages 30–39, Berlin, Germany, 2000. Springer-Verlag.

[27] Gabriel Lopes António Ribeiro and João Mexia. Using confidence bands for alignment with hapaxes. In Hamid Arabnia, editor, *Proceedings of the International Conference on Artificial Intelligence (IC'AI 2000)*, volume II, pages 1089–1095, Athens, Georgia, U.S.A., 2000. Computer Science Research, Education and Applications Press. Las Vegas, U.S.A., 2000 June 26-29.

[28] Gabriel Lopes António Ribeiro and João Mexia. Using confidence bands for parallel texts alignment. In *Proceedings of the 38th Conference of the Association for Computational Linguistics (ACL 2000)*, pages 432–439. Association for Computational Linguistics, 2000. Hong Kong, China, 2000 October 3-6.

[29] F. Azevedo and P. Barahona. Applications of an extended set constraint solver. In *Procs. of ERCIM/COMPULOG Workshop on Constraints*. Univ. Padova, 2000.

[30] F. Azevedo and P. Barahona. A constraint programming approach to model ATPG related problems. In *Procs. of ETW 2000: IEEE European Test*, May 2000.

[31] F. Azevedo and P. Barahona. Differentiating diagnostic theories through constraints over an eight-valued logic. In W. Horn, editor, *Proceedings of ECAI'2000, 14th European Conference on Artificial Intelligence*, volume 54 of *Frontiers in Artificial Intelligence and Applications*, pages 73–78. IOS Press, 2000.

[32] F. Azevedo and P. Barahona. Modelling digital circuit problems with set constraints. In J. Lloyd, V. Dahl, U. Furbach, M. Kerber, K.-L. Lau, C. Palamidessi, L. Moniz Pereira, Y. Sagiv, and P.J. Stuckey, editors, *Computational Logic - CL 2000*, volume 1861 of *Lecture Notes in Computer Science*, pages 414–428. Springer, 2000.

[33] João Balsa and Gabriel Lopes. A distributed approach for a robust and evolving NLP system. In Dimitis Christodoulakis, editor, *Natural Language Processing - NLP 2000, Second International Conference*, volume 1835 of *Lecture Notes in Artificial Intelligence*, pages 151–161, Berlin, Germany, 2000. Springer Verlag.

[34] P. Barahona, F. Azevedo, M. Veloso, N. Estevao, and R. Gallego. A computerised guideline for the management of diabetes. In *Proceedings of MIE'2000*, volume 77 of *Studies in Health Technology and Informatics*, pages 600–604. IOS Press, 2000.

[35] J. Cruz and P. Barahona. Handling differential equations with constraints for decision support. In Hélène Kirtchner and Christophe Ringeissen, editors, *Frontiers of Combining Systems - FroCoS 2000*, volume 1794 of *Lecture Notes in Artificial Intelligence*, pages 105–120. Springer, 1999.

[36] Carlos Viegas Damásio. A distributed tabling system. In *Proceedings of Tabulation in Parsing and Deduction 2000 (TAPD 2000)*, pages 65–76, Vigo, September 2000.

[37] Carlos Viegas Damásio and Luís Moniz Pereira. Hybrid probabilistic logic programs as residuated logic programs. In M. O. Aciego, I. P. de Guzmán, G. Brewka, and L. M. Pereira, editors, *Logics in AI, Proceedings of JELIA'00*, pages 1362–1376, Málaga, Spain, September 2000. LNAI 1919, Springer–Verlag.

[38] G. Dias, S. Guilloré, J.C. Bassano, and J.G.P. Lopes. Combining linguistics with statistics for multiword term extraction: A fruitful association ? In *Recherche d'Informations Assistée par Ordinateur (RIAO)*, pages 1–20, Paris - France, April 2000.

[39] G. Dias, S. Guilloré, and J.G.P. Lopes. Benefiting from multi-domain corpora for extracting terminologically relevant multiword lexical units. In 9^{th} *EURALEX International Congress*, volume 1, pages 339–348, Stuttgart - Germany, August 2000.

[40] G. Dias, S. Guilloré, and J.G.P. Lopes. Extracting textual associations from part-of-speech tagged corpora. In *European Association for Machine Translation Workshop*, Ljubljana - Slovenia, April 2000.

[41] G. Dias, S. Guilloré, and J.G.P. Lopes. Extraction automatique d'associations textuelles à partir de corpora non traités. In M. Rajman and J-C. Chappelier, editors, *5es Journées Internationales d'Analyse Statistique des Données Textuelles*, pages 213–221, Lausanne, March 2000. Ecole Polytechnique Fédérale de Lausanne.

[42] G. Dias, S. Guilloré, and J.G.P. Lopes. Mining textual associations in text corpora. In *Workshop on Text Mining of the Sixth ACM SIGKDD International Conference on Knowledge Discovery an Data Mining*, pages 92–95, Boston, August 20-23 2000. 2 pages poster.

[43] G. Dias, S. Guilloré, and J.G.P. Lopes. Normalisation of association measures for multiword lexical unit extraction. In *International Conference on Artificial and Computational Intelligence for Decision, Control and Automation in Engineering and Industrial Applications*, pages 207–216, Monastir - Tunisia, March 2000.

[44] G. Dias and J.-H. Kaalep. Automatic extraction of multiword units for estonian: a comparison between annotated and non-annotated corpora. In *International Futuristic Conference on Language Development*, Talin, Estónia, March 2000.

[45] G. Dias, S. Madeira, S. Guilloré, and J.G.P. Lopes. Extrating concepts from dynamic legislative text collections. In *5th TELRI TransEuropean Language Ressource ans Infrastructure Seminar: How to extract meaning from corpora*, Ljubljana - Slovenia, September, 22-24 2000.

[46] Lígia Ferreira and Salvador Pinto Abreu. Design for AJACS, yet another Java Constaint Programming framework. In *Proceedings of AGP00: The 2000 Joint Conference on Declarative Programming*, December 2000.

[47] Berilhes Borges Garcia, Gabriel Pereira Lopes, and Fávio Varejão. Compiling default theory into extended logic programming. In M. C. Monard and J. S. Sichman, editors, *Advances in Artificial Intelligence: International Joint Conference 7th Ibero-American Conference on Artificial Intelligence and 15th Brazilian Symposium on Artificial Intelligence (IBERAMIA-SBIA 2000), Atibaia, SP, Brazil, November 19-22, 2000. Proceedings*, volume 1952 of *Lecture Notes in Artificial Intelligence*, pages 207–216, Berlin, Germany, 2000. Springer-Verlag.

[48] J. Gartner, T. Swift, A. Tien, C. V. Damásio, and L. M. Pereira. Psychiatric diagnosis from the viewpoint of computational logic. In J. Lloyd et al., editor, *Procs. of First International Conference on Computational Logic (CL 2000)*, pages 1362–1376, London, UK, July 2000. LNAI 1861, Springer–Verlag.

[49] J. Gartner, T. Swift, A. Tien, C. V. Damásio, and L. M. Pereira. Psychiatric diagnosis from the viewpoint of computational logic. In *7th Int. Conf. on Principles of Knowledge Representation and Reasoning, NMR ws on Abductive Reasoning*, Breckenridge, Colorado, USA, April 2000.

[50] G. Guimaraes. The discovery of sleep apnea with unsupervised neural networks. In *Proceedings of the 2000 International Conference on Mathematics and Engineering Techniques in Medicine and Biological Sciences (METMBS'2000), June 26-29, Monte Carlo Resort, Las Vegas, Nevada, USA*, pages 361–367, 2000.

[51] G. Guimaraes. The induction of temporal grammatical rules from multivariate time series. In A. L. Oliveira, editor, *Grammatical Inference: Algorithms and Applications, Proceedings of the 5th International Colloquium on Grammatical Inference (ICGI-2000), Lisbon*, volume 1891 of *Lecture Notes in Artificial Intelligence*, pages 127–140. Springer, 2000.

[52] G. Guimaraes. Temporal data mining for multivariate time series. In *Proceedings of the 2000 International Conference on Artificial Intelligence (IC-AI'2000), June 26-29, Monte Carlo Resort, Las Vegas, Nevada, USA*, pages 1379–1385, 2000.

[53] G. Guimaraes. Temporal knowledge discovery for multivariate time series with enhanced self-organizing maps. In *Proceedings of IEEE-INNS-ENNS Intl. Joint Conf. on Neural Networks (IJCNN2000), Como, 24-27 July, Italy*, volume 4, pages 165–170. IEEE, 2000.

[54] L. Krippahl and P. Barahona. PSICO: Combining constraint programming and optimisation to solve macromolecular structures. In *Procs. of ERCIM/COMPULOG Workshop on Constraints*. Univ. Padova, 2000.

[55] E. Lamma, L. M. Pereira, and F. Riguzzi. Logic aided lamarckian evolution. In R. Michalski and P. Brazdil, editors, *Fifth Int. Workshop on Multistrategy Learning*, pages 59–73. LIACC, 2000.

[56] J. A. Leite, J. J. Alferes, and L. M. Pereira. Dynamic logic programming with multiple dimensions. In L. Garcia and M. Chiara Meo, editors, *Procs of the APPIA-GULP-PRODE'00 Joint Conference on Declarative Programming (AGP'00)*, 2000.

[57] J. A. Leite, J. J. Alferes, and L. M. Pereira. Multi-dimensional dynamic logic programming. In F. Sadri and K. Satoh, editors, *Procs of the CL-2000 Workshop on Computational Logic in Multi-Agent Systems (CLIMA'00)*. Imperial College, 2000.

[58] J. A. Leite, F. C. Pereira, A. Cardoso, and L. M. Pereira. Metaphorical mapping consistency via dynamic logic programming. In G. Wiggins, editor, *Procs. of the AISB'00 Sysposium on Creative and Cultural Aspects and Applications of AI and Cognitive Science*, pages 41–50. Springer, AISB.

[59] Ricardo Lopes, Fernando Silva, Vítor Santos Costa, and Salvador Abreu. The RAINBOW: Towards a Parallel BEAM. In *CL'2000 Workshop on Parallelism and Implementation Technologies for (Constraint) Logic Programming Languages*, July 2000.

[60] S. Nascimento. Proportional membership for fuzzy clusterinng via alternating cluster estimation. In *Proceedings of the 8th Conference on Information Processing and Management of Uncertainty in Knowledge-Based Systems, IPMU 2000*, pages 1977–1981, Madrid, Spain, 3-7 July, 2000, 2000. Universidad Politécnica de Madrid.

[61] S. Nascimento, B. Mirkin, and F. Moura-Pires. A fuzzy clustering model of data and fuzzy c-means. In *Proceedings of The 9th IEEE International Conference on Fuzzy Systems, Fuzz-IEEE 2000. Soft Computing in the Information Age*, pages 302–307, San Antonio, Texas USA, May 7-10, 2000, 2000. IEEE Neural Networks Council, IEEE Press (ISSN 1098-7584).

[62] S. Nascimento, B. Mirkin, and F. Moura-Pires. A fuzzy clustering model of data with proportional membership. In Thomas Whalen, editor, *Proceedings of The 19th International Meeting of the North American Fuzzy Information Processing Society (NAFIPS 2000)*, pages 261–267, Atlanta USA, 13-16 July 2000, 2000. IEEE Press.

[63] J. Moura Pires and Henri Prade. Flexibility as relaxation - the fuzzy set view. In *Soft Constraints: Theory and Practice (workshop associated to CP'00 - 6th Int. Conf. on Principles and Practice of Constraint Programming*, 2000.

[64] J. Moura Pires, Henri Prade, and Didier Dubois. Specifying fuzzy constraints interactions without using aggregation operators. In *Procs. 7th IEEE Int. Conf. on Fuzzy Systems*, pages 228–233. IEEE, 2000.

[65] Paulo Quaresma and Irene Pimenta Rodrigues. Automatic classification and intelligent clustering for wwweb information retrieval systems. In J. Moreton, editor, *In BILETA'2000 – 15th Annual BILETA (British and Irish Legal Education Technology Association)*, Coventry, UK, April 2000. University of Warwick, UK.

[66] Paulo Quaresma and Irene Pimenta Rodrigues. Cooperative Information Retrieval Dialogues through Clustering. In Petr Sojka, Ivan Kopeček, and Karel Pala, editors, *Proceedings of the Third International Workshop on Text, Speech and Dialogue—TSD 2000*, Lecture Notes in Artificial Intelligence LNCS/LNAI 1902, pages 415–420, Brno, Czech Republic, Sep 2000. Springer-Verlag.

[67] Paulo Quaresma and Irene Pimenta Rodrigues. Cooperative information retrieval dialogues through clustering. In Petr Sojka, Ivan Kopeček, and Karel Pala, editors, *TSD 2000 - Third International Workshop on TEXT, SPEECH and DIALOGUE, Brno, Czech Republic, September, 2000, Proceedings*, volume 1902 of *Lecture Notes in Artificial Intelligence LNCS/LNAI*, pages 415–420, Berlin, Germany, 2000. Springer-Verlag.

[68] Paulo Quaresma and Irene Pimenta Rodrigues. A dialogue manager for a www-based information retrieval system. In H. Larsen, J. Kacprzyk, S. Zadrozny, T. Andreasen, and H. Cristiansen, editors, *FQAS 2000: Fourth International Conference on Flexible Query Answering Systems*, Advances in Soft Computing, pages 592–601. Physica-Verlag, Heidelberg, New York, October 2000.

[69] Paulo Quaresma and Irene Pimenta Rodrigues. An information retrieval system with cooperative behaviour. In Torbjorn Nordgard, editor, *NODALIDA – Proceedings from the 12th Nordiske datalingvistikkdager*, pages 183–190, Trondheim, Norway, 2000. Dep. of Linguistics, Norwegian University of Science and Technology.

[70] Paulo Quaresma and Irene Pimenta Rodrigues. A logic programming agent for controlling distributed web dialogues. In Osamu Yoshie, editor, *INAP'2000 - The 13th International Conference on Applications of Prolog*, pages 46–53, Tokyo, Japan, October 2000. Ren Associates Inc. ISSN 1345-0980.

[71] Paulo Quaresma and Irene Pimenta Rodrigues. Using knowledge to model cooperative information retrieval dialogues. In G. Callaghan Y. Wilks, editor, *Proceedings of the 3rd International Workshop on Human-Computer Conversation*, pages 142–147, Bellagio, Italy, July 2000. Dep. of Computer Science, University of Sheffield, UK.

6.5 Other publications

[72] J. J. Alferes and D. Pearce. *Semantics of Logic Programs and Non-monotonic Reasoning.* FOLLI, 2000. ESSLLI Course notes (287 pages).

[73] M. Zerbst, L. Tschiersch, M. Talbi, G. Guimaraes, and W. Urfer. Clustering algorithms for aerial photographs and high resolution satellite images. In *Technical Report TR-28/2000 (http://www.statistik.uni-dortmund.de/ sfb475/sfblit.html), Dep. of Statistics, University of Dortmund*, 2000.

[74] G. Guimaraes and W. Urfer. Self-organizing maps and its applications in sleep apnea research and molecular genetics. In *Technical Report TR-23/2000 (http://www.statistik.uni-dortmund.de/sfb475/sfblit.html), Dep. of Statistics, University of Dortmund*, 2000.

7 Missions

Carlos Viegas Damásio

- London, UK, July 2000
  Purpose: Participation in the International Conference on Computational Logic (CL'2000)
- Málaga, Spain, September 2000
  Purpose: Participation in the European Workshop on Logics in Artificial Intelligence (JELIA'2000)

Francisco Azevedo

- Berlin, August 2000
  Purpose: Participation in ECAI 2000, 14th European Conference on Artificial Intelligence.
- London, UK, July 2000
  Purpose: Participation in the International Conference on Computational Logic (CL'2000)
- Padova, Italy, June 2000
  Purpose: Participation in the ERCIM/COMPULOG Workshop on Constraints

Gabriel Pereira Lopes

- Universidade de Aveiro, February 2, 2000
  Purpose: G.P. Lopes presented a talk on "Extraction of patterns of two or more units (words, characters, POS-tags), contiguous or not, from very large corpora: applications on IR, MT, etc." and discussed the viability of future co-operation with this University. Contact: Prof. Luis Seabra Lopes
- Faculdade de Ciências e Tecnologia da Universidade de Coimbra, February 8, 2000
  Purpose: G.P. Lopes was a member of the jury for Masters' examination of Francisco da Câmara Pereira. This visit was also used for discussing the plans of Prof. Amilcar Cardoso about the application non-symbolic techniques to Learning in the area of Natural Language Processing. Contact: Prof. Amilcar Cardoso
- San Francisco, California, USA, February 10-11, 2000
  Purpose: G.P. Lopes was member of the evaluation panel of project proposals costing above 500,000 USD, submitted to National Science Foundation in the framework of Information Technology Research (ITR) initiative.
- Universidade Federal do Espírito Santo, Vitória, Brazil, February 22 till March 9, 2000
  Purpose: G.P. Lopes worked with his Ph.D. students, Sérgio Freitas and Berilhes Garcia. This mission was also used in order to identify possible future co-operation on e-learning, based on statistically-based classification of questions, work prepared by students and materials in digital libraries used as support for lessons teached. Contact: Prof. Crediné Menezes
- Pontifícia Universidade Católica do Rio Grande do Sul,Porto Alegre, Brazil, March 9-28, 2000
  Purpose: in the framework of project FUNDAÇÕES, J.G.P. Lopes participated in jury that evaluated the Ph.D. thesis work done by Michael Móra that was supervised by Gabriel Pereira Lopes and Rosa Viccari. J.G.P. Lopes acted as member of the jury for Masters' examination of Guilherme Dhein who submitted the thesis "Integrating deliberation and reactivity in a homogeneous hybrid Agents' Architecture", supervised by Prof. João Batista Oliveira. This mission was mainly used for showing how multi-word lexical units, automatically extracted from large corpora, could be used for Infromation Retrieval, Digital Libraries and unsupervised document classification. Contact: Prof. Vera Strube de Lima

- Instituto de Informática da Universidade Federal do Rio Grande do Sul, em Porto Alegre, Brazil, March 21, 2000
  Purpose: G.P. Lopes presentated a talk on "Information Retrieval" in the Workshop on Artificial Intelligence — co-operation Brazil-Portugal. Contact: Prof. Rosa Viccari.
- Instituto de Linguística da Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil, March 22, 2000
  Purpose: G.P. Lopes discussed the use of statistical techniques for aiding the construction of terminologies. From this meeting there was a concrete work of the extraction of terminology used in the Brazilian Constitution of 1988. Contact: Prof. Anna Becker Maciel
- UNISINOS, near Porto Alegre, Brazil, March 23, 2000
  Purpose: G.P. Lopes discussed the viability of future co-operation with this University in the area of Digital libraries and anaphora resolution using statistical methods. Contact: Prof. Renata Vieira
- Universidade Estadual de Pelotas, Rio Grande do Sul, Brazil, March 27, 2000
  Purpose: G.P. Lopes checked how did the project on sign languages evolved since his last visit in April 1999. There were meetings with students working in this project. Contact: Prof. Antônio Rocha Costa
- Jurifor (a Portuguese enterprise working in information retrieval in the area of case-law) April 11, 2000
  Purpose: G.P. Lopes, Nuno Marques and Paulo Quaresma discussed possible future co-operation. Contact: Nuno Machado Mendonça (JURINFOR director).
- Macau, Brokerage event EUREKA [meets] Asia, organised by Portuguese Funding Agência de Inovação, May 21-24, 2000
  Purpose: G.P. Lopes participated in this event in order to meet possible Asian partners for future co-operation. Contact: Agência de Inovação
- Universidade de Macau, Faculdade de Ciências e Tecnologia, Macau, May 24, 2000
  Purpose: G.P. Lopes discussed possible co-operation on Machine Translation for the pairs Portuguese, English and Chinese and gave a talk on "Automatic parallel text alignement, translation equivalents extraction and multi- word units extraction from large text collections". Contact: Prof. Li Yi Ping
- Instituto Politécnico of Macau, May 23, 2000
  Purpose: G.P. Lopes discussed with the responsible for the teaching of Chinese to Portuguese speaking people. Contact: Director of Instituto Politécnico of Macau.
- European Commission, Brussels, June 4-10, 2000
  Purpose: G.P. Lopes evaluated European projects in the area of Human Language Technologies, IST programme. Contact: Roberto Cencioni
- Gotemburg, Sweden, June 14, 2000
  Purpose: G.P. Lopes made the final evaluation of European project TRINDI, from Language Engineering Programme Contact: Robin Cooper
- PARAREDE, June 28, 2000
  Purpose: G.P. Lopes discussed on possible technological transfer on Information Retrieval Contact: Rui Ferraz and Pedro Monteiro.
- São Paulo, Brazil, July 2000, second fortnight on Information Technologies, a brokerage event Purpose: Paulo Quaresma presented and made known the results obtained with projects PGR and IGM.
- Laboratoire dÍnformatique de Marseille, July 18-26, 2000
  Purpose: co-operation in the framework of the project "Analysis and synthesis of sentences in Portuguese and French". This mission was also used for G.P. Lopes to participate, as 'rapporteur', in the jury of the Ph.D. thesis of Pascal Mouret Contact: Paul Sabatier and Robert Pasero.

- San Millan de la Cogolla, Spain, September 19-23, 2000
  Purpose: J.G.P. Lopes was invited for giving a talk on *"Automating the Annotation of Portuguese Medieval Text"*. This talk was given in the framework of the Inter-Latin Summer School on Mathematics and Corpus Handling, organised by the Spanish Academia of Sciences, by the Academia of French Language, by the French Ministry of Culture and by the University of Pisa.
- XVI Congreso de la Sociedad Española para el Procesamiento del Lenguaje Natural (SEPLN 2000), Vigo, Spain, September 26-28, 2000
  Purpose: J.G.P. Lopes discussed with the Spanish Association for Computational Linguistics about the creation of an Iberian Association for Computational Linguistics. Contact: Manuel Vilares Ferro
- Universidade Federal de Santa Catarina, Departamento de Informática e Estatística, Florianópolis, Brazil, October 28 till November 5, 2000
  Purpose: G.P. Lopes discussed about possible future co-operation in the areas of Infortion Retrieval, e-learning and Natural Language Processing (NLP). He has also given a talk on "Statistical methods for NLP". Contact: Prof. Raul Wazlawick
- Pontifícia Universidade Católica do Rio Grande do Sul (PUCRS),Porto Alegre, Brazil, November 5-18, 2000
  Purpose: J.G.P. Lopes starts a 30 hours course on *Advanced Topics in Artificial Intelligence* in the framework of the Post-graduation programme of PUCRS. This course was taught in collaboration with Prof. Nuno Marques, from Universidade Aberta, and researcher of CENTRIA, who stayed in Porto Alegre from November 23 till December 13, 2000, in the framework of the activities of FUNDAÇÕES project. Contact: Vera Strube de Lima
- Joint Ibero-American Conference on AI (IBERAMIA'00) and Brazilian Symposium on AI (SBIA'00), and 6th Workshop on Portuguese Language Processing (PROPOR'00), Atibaia, S. Paulo, Brazil, November 18-22, 2000
  Purpose: J.G.P. Lopes presents two papers in the joint conferences on *"Compiling Default Theory into Extended Logic Programming"* and *"Extracting Equivalents from aligned parallel texts — comparison of measures of similarity"*. In the framework of these conferences J.G.P. Lopes participates in the debates inside the organisation committee for the next IBERAMIA'02. The conference was used for making as many contacts as it was possible.
- Universidade de São Paulo, Departamento de Ciência da Computação, Instituto de Matematica e Estatistica and Departamento de engenharia informática, November 22-25, 2000
  Purpose: G.P. Lopes deepened the contacts made earlier in order to enable future co-operation on POS-tagging and on MT for the pair of languages Portuguese-Japanese. J. G.P. Lopes presents a talk on "Using localmax algorithm for extracting information patterns from large corpora and applications". This visit was used for discussing with two Masters about the possibility for collaborative work for supervision of their Ph.D. thesis. Contacts: Prof. Marcelo Finger (Instituto de Matematica e Estatistica) and Jorge Kinoshita (Departamento de Engenharia Informática).
- D Universidade Federal do Espírito Santo, Departamento de Informática, Vitória, Brazil, November 25 till December 1, 2000
  Purpose: G.P. Lopes worked with Berilhes Borges Garcia and Sérgio Freitas in order to discuss about the Ph.D. thesis of Berilhes Garcia, that had previously been submitted for examination and for discussing about on going writing of the Ph.d. Thesis of Sérgio Freitas. This visit was also used for discussing on the possible co-operation on e-learning and for meeting the Brazilian company MOGAI that is interested on technological transfer of Portuguese know-how in the area of Information retrieval. Three talks were given: *Multi-Agents for distributed detection and repairing of faults during text processing*, *Using localmax algorithm for extracting information patterns from large corpora*

and applications and *Statistically grounded alignement of parallel texts and translation equivalents extraction.*

- PARAREDE, December 6, 2000
  Purpose: G.P. Lopes had a working reunion with directors of PARAREDE in order to deepen matters previously discussed on technological transfer, namely on automatic thesauri construction. Contact: Rui Ferraz and Pedro Monteiro.
- Instituto Geológico e Mineiro, December 12, 2000
  Purpose: G.P. Lopes presented and demonstrated the system for information retrieval, developed in the framework of European project GEOMIST-GEOAMB. It was shown at this occasion that it is possible to integrate two complementary systems: one for Information Retrieval and another for geographic information.

Gabriela Guimarães

- Department of Statistics, University of Dortmund, Germany, March, 2000
  Purpose: Series of Graduate Courses
- Monte Carlo Resort, Las Vegas, Nevada, USA, June, 2000
  Purpose: Proceedings of the 2000 International Conference on Artificial Intelligence (IC-AI'2000) and International Conference on Mathematics and Engineering Techniques in Medicine and Biological Sciences (METMBS'2000)
- Como, Italy, July, 2000
  Purpose: IEEE-INNS-ENNS Intl. Joint Conf. on Neural Networks (IJCNN'2000)
- Lisbon, September 2000
  Purpose: 5th International Colloquium on Grammatical Inference (ICGI-2000)
- Department of Statistics, University of Dortmund, Germany, March, 2000
  Purpose: Graduate College in Applied Statistics

João Alexandre Leite

- London, UK, July 2000
  Purpose: Participation in the International Conference on Computational Logic (CL'2000)
- Birmingham, UK, April 2000
  Purpose: Participation in the AISB'00 Symposium on Creative and Cultural Aspects and Applications of AI and Cognitive Sciences
- Birmingham, UK, August 2000
  Purpose: Participation in the European Summer School on Logic Language and Information (ESSLLI'00)

João Moura Pires

- Singapura, September 2000
  Purpose: Participation in the International Workshop on Soft Constraints: Theory and Practice and the the the Sixth International Conference on Principles and Practice of Constraint Programming (CP'2000).

Jorge Cruz

- Nancy, February 2000
  Purpose: Participation in FroCoS 2000, Frontiers of Combining Systems.

José Júlio Alferes

- London, UK, July 2000
  Purpose: Participation in the International Conference on Computational Logic (CL'2000)

- Birmingham, UK, August 2000
  Purpose: To give a course at the European Summer School on Logic Language and Information (ESSLLI'00)
- La Habana, Cuba, December 2000
  Purpose: Participation in the Joint Conference on Declarative Programming (AGP'2000)

Lígia Ferreira

- La Habana, Cuba, December 2000
  Purpose: Participation in the Joint Conference on Declarative Programming (AGP'2000)

Luís Moniz Pereira

- Guimarães, June 2000
  Purpose: Participation in the Workshop on Multistrategy Learning (MSL'2000)
- London, UK, July 2000
  Purpose: Participation in the Conference on Computational Logic (CL'2000)
- Málaga, Spain, September 2000
  Purpose: Participation in the European Workshop on Logics in Artificial Intelligence (JELIA'2000)

Nuno Marques

- Pontifícia Universidade Católica do Rio Grande do Sul (PUCRS),Porto Alegre, Brazil, November 5-18, 2000
  Purpose: Teaching a 30 hours course on *Advanced Topics in Artificial Intelligence* in the framework of the Post-graduation programme of PUCRS.
- Porto Alegre from November 23 till December 13, 2000
  Purpose: Activities of FUNDAÇÕES project.

Paulo Quaresma

- Varna, Bulgary, September 2000
  Purpose: Participation in the International Conference on Artificial Intelligence – Methodology, Systems and Applications (AIMSA'2000)
- São Paulo, Brazil, July 2000, second fortnight on Information Technologies, a brokerage event
  Purpose: Paulo Quaresma presented and made known the results obtained with projects PGR and IGM.

Pedro Barahona

- Berlin, August 2000
  Purpose: Participation in ECAI 2000, 14th European Conference on Artificial Intelligence.
- Hannover, August 2000
  Purpose: Participation in MIE´2000, Medical Informatics in Europe.
- London, UK, July 2000
  Purpose: Participation in the International Conference on Computational Logic (CL'2000)
- Rio de Janeiro, Brazil, April 2000
  Purpose: Visit to Pontifícia Universidade Católica (PUC) and prepare joint work with Celso Ribeiro

Salvador Pinto Abreu

- Boston, MA, Janyary 2000
  Purpose: Participation in the 2nd International Workshop on Practical Aspects of Declarative Languages (PADL'2000).
- London, UK, July 2000
  Purpose: Participation in the International Conference on Computational Logic (CL'2000)
- Paris, France, August/September 2000
  Purpose: to work with Daniel Diaz and Philippe Codognet on the development of the OAR and AJACS prototypes.

Susana Nascimento

- San Antonio, Texas USA, May 7-10, 2000
  Purpose: Participation on 'The 9th IEEE International Conference on Fuzzy Systems (Fuzz-IEEE 2000)'.
- Madrid, Spain, 3-7 July, 2000
  Purpose: Participation on 'The 8th Conference on Information Processing and Management of Uncertainty in Knowledge-Based Systems (IPMU 2000)'.
- Atlanta USA, 13-16 July 2000
  Purpose: Participation on 'The 19th International Conference of the North American Fuzzy Information Processing Society (NAFIPS 2000).
- Schloss Dagstuhl, Wadern, Germany, August, 13-19 2000
  Purpose: Participation in the Dagstuhl Seminar 00331 on *Intelligent Data Analysis*, having presented an invited talk on *Data-Driven Fuzzy Cluster Modelling*.

8 Visitors

Antonio Brogi , University of Pisa, 2 weeks, September 2000. Collaboration in program composition and logic programming for multi-agent systems. Preparation of a bilateral project proposal on these topics.

de Gregory Grefenstette , Xerox Research Centre Europe, Grenoble Site, France, September 14-17, 2000. Co-operation on Natural Language Learning. Tutorial presentation on *Techniques for automatically deriving thesaurus from text* in the framework of the Advanced Artificial Intelligence School organised by J.G.P.Lopes EAIA'00.

Dunja Mladenic , Jozef Stefan Institute, Ljubljana, Slovenija and Carnegie Mellon University, School of Computer Science, USA, September 12-17, 2000.Tutorial presentation on *Document categorization by modelling human expert* in the framework of the Advanced Artificial Intelligence School organised by J.G.P.Lopes EAIA'00.

Fabrizio Riguzzi , University of Bologna, Italy, 1 week, June 2000. Collaboration on inductive learning, and combination of belief revision and genetic algorithms.

Henri Prade , University Paul Sabatier, France, 1 week, July 2000. Participation in the PHD Jury of João Moura Pires.

José Rafael , Professor of Departamento de Electrónica e Telecomunicações — IEETA, Universidade de Aveiro and Vice-rector of the same University, December 14, 2000. This visit was intended for discussing a possible co-supervision of the Ph.D. Thesis by Rui Ribeiro, Assistant of that Department. Later this discussion gave ride to a formal acceptation of this task.

Jürgen Dix , Manchester University, UK, 1 week, January 2000. Collaboration on agent programming in the context of PRAXIS project MENTAL.

Michael Trosset , University of William and Mary, VA, USA, 1 week, June 2000. Collaboration on Computational Geometry and non-linear optimisation.

Paul Sabatier , Laboratoire dÍnformatique de Marseille, February 4-9, 2000. This visit was done in the framework of the project project "Analysis and synthesis of sentences in Portuguese and French", funded by ICCTI and CNRS.

Pierangelo Dell'Acqua , U. Uppsala, Sweden, from mid January to December 2000. Collaboration on logic programming agent architectures in the context of PRAXIS project MENTAL.

Raymond Mooney , Department of Computer Sciences, The University of Texas at Austin, U.S.A., September 9-16, 2000. Future co-operation on Natural Language Learning, tutorial presentation on *"Inductive Logic Programming for Natural Language"* in the framework of the Advanced Artificial Intelligence School organised by J.G.P.Lopes EAIA'00.

Sérgio Freitas , from January 19 till February 22, 2000. This visit was programmed so that this Ph.D. student could continue to work on his Ph.D. thesis.

Terrance Swift , U. Stony Brook, USA, 2 month, May 2000. Collaboration on abduction in well founded semantics, psychiatric diagnosis, annotated logic programs, and application of assignable variables to relevant tabling and constructive negation.

Thomas Eiter , Technical University of Wien, Austria, 1 week, January 2000. Collaboration on preferences and updates in logic programming, in the context of PRAXIS project MENTAL.

Vera Strube de Lima , Director of the Informatics Faculty of the Pontifícia Universidade Católica do Rio Grande do Sul (PUCRS),Porto Alegre, Brazil, fro January 6 till February 2, 2000. This visit was programmed in the framework of project FUNDAÇÕES.

V.S. Subrahmanian , University of Maryland, USA, 1 week, January 2000. Collaboration on agent programming and paraconsistent logic programming in the context of PRAXIS project MENTAL.

Walter Daelemans , CNTS Language Technology Group GER - Linguistics, University of Antwerp (UIA), Belgium, September 12-17, 2000. Co-operation on Natural Language Learning. Tutorial presentation on *Memory-Based Language processing: Applications in Language Engineering* in the framework of the Advanced Artificial Intelligence School organised by J.G.P.Lopes EAIA'00.

9 CENTRIA evolution graphics in 2000