CENTRIA
Centro de Inteligência Artificial – UNL

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2008 Report of Activities

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Contents

1 General assessment of activities in 2008

The present activity report was approved by the Scientific Committee of CENTRIA in June 2009. The plans approved in 2007 for 2008 were on the whole successfully carried out.

1.1 Unit Description: Form of organization and management

Hosted at the Department of Computer Science of the Faculty of Science and Technology of The New University of Lisbon (FCT/UNL), the centre also has members (all with a PhDs) from the University of Évora (4), the University of Coimbra (1), and the UNL Faculty of Social Sciences and Humanities (FCSH/UNL) (1). A number of researchers from other universities (University of Lisbon, IST Lisbon, University of Coimbra, University of Linkoping, Sweden, and University of Cardiff, Wales) are associate members. The Centre naturally includes a significant number of postdocs, post-graduate students and collaborators that have common research activity with its members.

At present the Centre has a Director, that represents the Centre externally, and an Executive Board composed of 3 members which, together with the Director, makes the main executive decisions. The Centre comprises a Scientific Council (those with a PhD degree), that not only elects the Director and the members of the Scientific Board but also must vote and approve the admission and exclusion of Members, and the general policies undertaken by the Centre, namely the yearly Reports of Activities, Future Plans, and Budgets.

The Centre has its own Advisory Board, composed of leading international researchers (Robert Kowalski, David S. Warren, Fernando Pereira, Ivan Bratko, and Joerg Siekmann), which is appraised of the Centre's activities and plans, and produces comments and suggestions towards their improvement.

The activities of the Centre are organised in three main sub-areas:

- Knowledge Representation and Reasoning, and Logic Programming;
- Intelligent Information Systems; and
- Soft Computing and Constraints.

Each of these sub-areas has a coordinator in the Executive Board, but the sub-areas are not exclusive, in the sense that the members of the Centre are encouraged to collaborate in more than one sub-area, in order to exploit synergies and increase interdisciplinarity within the different sub-areas.

1.2 General Objectives of the unit as a whole

Knowledge Representation and Reasoning, and Logic Programming (KRRLP) The current aim of this area is to further develop the work on Logic Programming (LP) and its application to Knowledge Representation and Reasoning (KRR). This area focuses its activities on the following main topics: foundational research in the areas of rational computational logic agents, logic programs and knowledge base updates, and formal epistemology; a general framework for integrating several reasoning forms for uncertainty (including fuzzy-logic, possibilistic logic, probabilistic systems, and non-monotonic logics); distributed tabling and revision systems; computational models and their implementation for a parallel and distributed logic programming language.

Intelligent Information Systems (IIS) In this area, research work covers the following topics: semantic web definitions, tools for semantic web-based integration of heterogeneous databases, intelligent agents for automatic classification of documents, definition of semantic web ontologies, and natural language dialogue systems for information retrieval from intelligent Information systems.

Recent work in IIS includes: Semantic Web definition, Tools for semantic web based integration of heterogeneous databases, intelligent agents for automatic classification of documents and

definition of semantic web ontologies, natural language dialogue systems for information retrieval from intelligent Information systems and Data Warehouse Design and Query.

Soft Computing and Constraints (SCC) The planned research activity will not only extend ongoing work, but also explore new directions in both fundamental and applied research. In the latter, and enlarging the scope of our long term interest in applications of AI in Medicine, we intend to address more applications in Bioinformatics and clinical medical informatics.

Recent work in SCC includes: integration of local search and constraint propagation, improvement of interaction of constraint propagation techniques with Computational Geometry methods, development of sets constraints solver, approaching different optimisation problems, work on global constraints, spatial constraints, and over-constrained problems, development of search techniques.

CENTRIA team covers a sufficiently large spectra of related research topics in the areas of constraint satisfaction and optimisation, as well as automated learning and data mining, so as to make it possible to share experiences and take advantage of the synergies and cross-fertilisation that is possible within this area, as well as with other areas in CENTRIA.

1.3 Main Achievements during the year of 2008

Sub-Area Knowledge Representation and Reasoning and Logic Programming

A1 The successful completion of project *Rewerse*, a large, four-year European project that strongly involved the KRR&LP section, notably those working on the Semantic Web.

A2 The successful completion of project *PROGICNET*, a two-year European project supported by The Leverhulme Trust. The results of project PROGICNET will appear in a book, *Probabilistic Logics and Probablistic Networks*, under contract with the Synthese Library, Springer.

A3 Two PhD theses were successfully defended: Federico Banti's, *Evolving Logic Programs*, supervised by José Alferes, and João Alcântara's, *Paraconsistency, disjunction, and uncertainty in Logic Programming*, supervised by Carlos Damásio and Lus Moniz Pereira.

A4 Alfredo Gabaldon and Marco Alberti joined CENTRIA as CIÊNCIA 2008 senior researcher scientists, and Ricardo Gonçalves joined CENTRIA as a post-doctoral fellow.

A5 Continued work on the dynamic knowledge representation language EVOLP.

Sub-Area Intelligent Information Systems

B1 Vitor Nogueira successfully defended his PhD thesis in November 2008.

B2 Continued development of a Question-Answering system using results from previous research on semantic web ontologies, and natural language dialogue systems for information retrieval.

B3 Continued research on structural bioinformatics, focusing on the problem of modeling transient protein complexes and also the problem of integrating bioinformatics data and web services.

B4 A preliminary implementation of a probabilistic logic system in XSB prolog as part of a project to extend RuleML to handle fuzzy and approximate rules.

B5 A new FCT project was approved to begin in 2009, project MEDON, aimed to develop medical ontologies.

Sub-Area Soft Computing and Constraints

C1 Continued Development of an original Constraint Programmingplatform (Casper), ranked 2nd place in the Constraint Solvers competition, suitable for many applications, including structural Bioinformatics (e.g., Protein Structure Determination and docking, RNA Structural determination).

C2 A new constraints project, AutoDynAgents, supervised by Francisco Azevedo and in collaboration with GECAD, started in 2008.

C3 Olivier Perriquet's combinatorial game, ALPHA, was a awarded first prize at the international competition of the CNJ (Centre National du Jeu) in Paris. In addition to developing a new fast RNA secondary structure software, Perriquet has also given invited lectures on the relationships between art and science at Castel of Bostz and École des Beaux-arts de Nancy.

C4 Work on feature extraction from Oceanographic images, namely regarding image pre-processing for Eddy border recognition, including fuzzy clustering techniques for the problem of colour image segmentation, evolutionary programming for neural network training, and a random ellipse fitting algorithm.

C5 In other work in oceanography, validation techniques for biomass estimates based on satellite ocean color imaging have been successfully developed.

1.4 Integrative/multidisciplinary activities in 2008

To complement CENTRIA's expanding research in bioinformatics, we began to branch into medical clinical informatics by initiating a partnership with mdlogics, a medical software company in Baltimore, Maryland, which has close ties to the Johns Hopkins School of Medicine (JHSM). Terry Swift and Gregory Wheeler participated in project meetings with mdlogix/JHSM, resulting in a project proposal submitted to the National Institutes of Health (NIH) and a focused proposal submitted to the Portuguese Science Foundations (FCT/MCES) in 2009.

Gregory Wheeler continued strengthening CENTRIA's ties to the philosophy, statistics, and logic communities at Carnegie Mellon University by hosting Richard Scheines at CENTRIA in June 2008, then spending part of the fall 2008 in Pittsburgh.

1.5 Staff Changes

Professor Lus Moniz Pereira, founder of CENTRIA and its longstanding director, retired from the Department of Computer Science in 2008 and stepped down as director of CENTRIA. In October, CENTRIA members voted to elect Professor Pedro Barahona as the new director of CENTRIA and to elect Gregory Wheeler to replace the open seat on the executive board.

Alfredo Gabaldon and Marco Alberti joined CENTRIA as senior research scientists, under the CIÊNCIA 2008 program, and Ricardo Gonçalves joined as an FCT/MCES supported post-doc researcher.

1.6 Awards

José Alferes and Reinhard Kahle both successfully defended their 'Agregação'. Marco Correia developed a new interface for the Grasper graph solver, running on platform Casper, which won second place in one of the categories at the Solvers competition (CPAI08). Olivier Perriquet won first prize for a combinatorial game that he invented, called ALPHA, at the international competition of the CNJ (Centre National du Jeu) in Paris. Han The Ahn, an EMCL MSc student supervised by Luís Moniz Pereira, was the recipient of an APPIA 2008 AI award for his thesis project. Luís Moniz Pereira joined the editorial board of the new *Journal of Algorithms in Cognition*, and Gregory Wheeler joined the editorial board of *Philosophy of Science in Europe*, a Springer series.

1.7 Projects and Education Networking

New Projects Project PSE, "Philosophy of Science in Europe", began in 2008. This ESF network project will run for five years. Gregory Wheeler is both a participant in the formal methods group, and a member of the steering committee. Project DiFoS, "Dialogical Foundations of Semantics", was approved, to start in 2009. Reinhard Kahle is co-PI. CENTRIA prepared 15 project proposals, 8 of which to be headed by CENTRIA members, to be submitted to FCT/MCTES, for the call `https://www.fct.mctes.pt/projectos/`

Continuing Projects: CENTRIA members, through the department of Computer Science, continue to participate in the research and education contracts between the Portuguese Government and Carnegie-Mellon University, and the University of Texas at Austin.

During academic year 2007/08, the "European MSc in Computational Logic (EMCL)", launched in 2004 and supported at UNL by CENTRIA members, continued its operation[1], with partial funding from the European Erasmus Mundus programme. We recall the objective of the program is to impart to the student a profound theoretical and practical knowledge required for professional practice in the field, to give him a survey of the individual disciplines of Computational Logic and to develop his ability to work according to scientific methods. In addition, the student is given the opportunity to plan his studies to fit a particular practical application. To acquire practice-oriented knowledge he may choose appropriate combinations of modules. By means of visits abroad and English as the language of instruction, the student is to be prepared for the increasing internationalism of science, commerce and industry.

In 2008, the consortium applied to Erasmus Mundus II to renew the 5-year contract and include a joint PhD program (EPCL). EPCL is in the continuation of the experience with EMCL, and represent a good consolidation of the consortium. The consortium for EPCL includes, besides UNL, also T.U. Dresden, T.U. Wien, F.U. Bozen-Bolzano, and also 3 third-country partnes, NICTA in Australia, Simon Fraser University in Canada, and Universidad de Chile in Chile.

Finally, José Alferes became the EMCL coordinator at UNL. He replaced Lus Moniz Pereira, who retired from the faculty in September 2008.

Completed Projects The 4-year European funded project, REWERSE - "Reasoning on the Web with Rules and Semantics", involving all areas of CENTRIA, which was initiated in March 2004 (Cf. `http://www.rewerse.org/` for project details and our activities in 2008), finished. The aim of REWERSE was to advance Web systems and applications sometimes referred to collectively as the Semantic Web. The term refers to one of the major current endeavours world wide in Information Technologies. CENTRIA's participation involved a coordinating role in one of the major work-packages, "Evolution and Reactivity". CENTRIA is a major participant in REWERSE's Education and Training work-package, besides its major participation in other important work-packages mentioned in the project, namely "Rule Markup", and "Bio-informatics", so that all of CENTRIA's areas are involved.

The 2-year 'Probabilistic Logic and Probabilistic Networks' (PROGICNET) project, funded by the Leverhulme Trust, finished in April 2008. The aim of this project was to provide a unified framework for several common probabilistic logic semantics and to provide a unified approximate proof method using methods from probabilistic graphical models. The project yielded several papers in journals and conference proceedings, a forthcoming monograph, a new journal (*The Reasoner*), and several workshops and tutorials given in Europe, the US, and India.

Education Networking CENTRIA continued its participation in *The Erasmus Mundus External Cooperation Window (EMECW)*, which funds exchanges between European universities and universities of 24 non-European countries. CENTRIA's application to partner with universities in Russia in February 2008 and it was successful.[2]

Two big events related to education activities took place in UNL, organised by us. The aforementioned European Agent System Summer School attracted 85 students at MSc and PhD level, and allowed our own student to attend international level courses, taught by 26 tutors. The EMCL's Students Workshop also took place in UNL, and attracted 40 EMCL students from from

[1] See `http://ssdi.di.fct.unl.pt/masters/mcl/` for details.

[2] Details can be found at `http://www.eahep.org/web/index.php/cooperation-projects/ec-funding-programmes/emecw.html`

the 5 partner in the consortium.

1.8 Evolution

The global indicators in Section 7 show and highlight our productivity indicators for 2008, compared with our recent history. Comparative for the last five years (2004-08) is summarized in the following table and in the appendix.

Table 1: Publication Indicators

	2004	2005	2006	2007	2008
Journal Publications	9	11	12	12	15
ISI Proceedings	22	25	16	21	21
Proceedings	24	25	25	31	30
Book Chapters	7	6	4	3	4
Sub-total:	62	67	57	67	70
MSc Theses	13	6	11	16	16
PhD Theses	1	1	0	0	3
Total:	76	74	68	83	92

1. Publications: CENTRIA members published
   (a) 15 articles in international journals during 2007-08, our highest output in this category to date;
   (b) 70 published papers overall, our highest yearly output to date;
   (c) in collaboration with 25 collaborators, roughly 1/3 of which from abroad.
2. Projects: Number of ongoing projects has remained constant from 2007: 16, half of which were funded by international agencies.
3. Events Organization:
   (a) José Alferes was co-chair of *EMCL Students Workshop* in Caparica, Portugal, February 2008.
   (b) Reinhard Kahle was co-organizer of the International Workshop on Proof, Computation, Complexity, PCC'08, which took place, in Oslo, Norway, August 2008
   (c) João Leite was chair of the *European Agent Summer School* (EASSS'08), in Caparica, Portugal, May 2008;
   (d) João Leite was co-chair of a *Non-monotonic Reasoning Workshop* (NMR) "Session on Declarative Programming Paradigms and Systems", Sydney, Australia, September 2008.

1.9 International Teaching

1. José Alferes made invited seminars on Semantic Web related topics in the University of New South Wales, Griffith Univeristy and The Australian National University.
2. João Leite gave a tutorial at 5th International Conference on Autonomous Agents and Multi-Agent Systems (AAMAS'08).
3. Luís Moniz Pereira gave a course on "Computational Logic Applications in Cognitive Sciences" at the ICCL Summer School 2008, in Dresden
4. Gregory Wheeler gave a tutorial on Probabilistic Logic at the Indian Institute of Technology Winter Logic School, IIT Kanpur

5. Postgraduate MSc and PhD students: 3 PhD theses were completed in 2008, and 19 MSc theses.

1.10 Budget and Centre Evaluation

The 2008 budget was executed according to plan. The Centre was evaluated by an international panel for the 2002-2006 period and the results of this report were delivered in December 2008. The Centre's ranking was downgraded from 4 to 3, on a five-point scale, which corresponds to a change in qualitative ranking from *Very Good* down to *Good*. However, there was compelling evidence for a negative bias in the evaluation of the group of Computer Science and Electrical Engineering (CS/EE) research centers for this evaluation period. As a result, we believe that CENTRIA's assessment is not accurate.

Specifically, the review panel's lowered overall assessment of CENTRIA appears to rest on the view that both our productivity and feasibility indicators had diminished during the period of evaluation. However, the data submitted to the review panel actually shows an improvement over our previous evaluation period in both of these categories, and in one of the two cases the improvement is dramatic—a five-fold increase over the previous evaluation period.

In addition to signing a group letter spelling out the case for a bias in the Computer Science and Electrical Engineering (CS/EE) evaluations, the CENTRIA board specifically appealed to FCT/MCES to request a re-evaluation; the case is pending as of the date of this report. The Advisory Committee was duly notified of this situation and has submitted a letter of support of our position to the ministry.

The distribution of the running funds among the members was made as usual on the basis of publication productivity, in number and type, according to a pre-defined set of rules we have been using over the past years. We made good in the 2008 budget the revision of points assigned to each publication type to further encourage publication in journals and highly recognized conferences.

See the CENTRIA web pages for more information.

2 Sub-areas activities in 2008

2.1 Knowledge Representation and Reasoning, and Logic Programming

The work on "Knowledge Representation and Reasoning, and Logic Programming" continued in the various aspects of foundations, implementations and applications, based on national and international projects, and with relations to the other areas, in particular to ISS via the applications and tools.

This year was marked with the successful end of a big European Project, Rewerse, in which the group has been strongly involved in the last 4 year. Another project at European level has also finish during 2008: PROGICNET. On the other hand a new ESF project, PSE, Philosophy of Science in Europe, has started in 2008, and another ESF project, DiFoS - Dialogical Foundations of Semantics, was approved this year, to start in March 2009. Several project proposal have been made, of which we expect to report on 2009.

This year was also marked by the fact that one new researchers in this scientific area, Alfredo Gabaldon, joined CENTRIA, with a 5-year Research Fellow contract of CIÊNCIA 2007, and one other researcher in this area, Marco Alberti, was selected to start his contract in the 1st of January 2009. Also Ricardo Gonçalves, got a pos-doc grant from FCT to work in this area. These new members are expected to have impact on the work in this area in the near future.

Two PhD theses were presented in 2008 in this area, from Federico Banti and João Alcântara, the first on Evolving Logic Programs, and the second on Paraconsistency, disjunction, and uncertainty in Logic Programming. Also two members of the centre working in this area have successfully defended their "Agregação": José Alferes and Reinhard Kahle. Several students did their MSc thesis in this area (cf. corresponding list). Here, it is worth mentioning that our MSc student Han The Anh received the "Prémio Nacional de Trabalhos de Licenciatura em Inteligência Artificial

2008" with his project work, supervised by Luís Moniz Pereira.

CENTRIA members have joined two more editorial boards of journals in this area. Namely:

- Luís Moniz Pereira joined the editorial board of the new *"Journal of Algorithms in Cognition, Informatics and Logic"*, published by Oxford University Press.
- Gregory Wheeler joined the editorial board of *"Philosophy of Science in Europe"*, which is a Springer series.

CENTRIA members co-organized the following scientific meetings in this area:

- João Leite was Co-Chair of *"Non-Monotonic Reasoning Workshop Session on Declarative Programming Paradigms and Systems for NMR"* 13 to 15 of September 2008, Sydney, Australia.
- José Alferes was Co-Chair of *"EMCL Students Workshop""* 21 and 22 February 2008, Caparica, Portugal.
- João Leite was chair of *"European Agent System Summer School (EASSS'08)"* 5 to 9 of May 2008, Caparica, Portugal.
- Reinhard Kahle was co-organizer of the International Workshop on Proof, Computation, Complexity, PCC'08, which took place in August 2008 in Oslo, Norway.

The education and training aspects have been covered by our MSc in Computer Science, and the European MSc. on Computational Logic (EMCL), as in previous years, and with extended support from Erasmus Mundus programme, for one year more than the initial contract. Moreover, during 2008 we have prepared two proposal to the Erasmus Mundus 2 programme, that were submitted in the beginning of 2009: one with a continuation of the EMCL programme, now reformulated, and another with a new European PhD on Computational Logic (EPCL). EPCL is in the continuation of the experience with EMCL, and represent a good consolidation of the consortium. The consortium for EPCL includes, besides UNL, also T.U. Dresden, T.U. Wien, F.U. Bozen-Bolzano, and also 3 third-country partnes, NICTA in Australia, Simon Fraser University in Canada, and Universidad de Chile in Chile. The PhD programme will start in 2010. Still related to education activities, 2 students from the EMCL did their project work in Australia, in result of the Action 3 funding reported last year, and one student did his work in IBM in Rome, in result of a collaboration effort with industry.

Two big events related to education activities took place in UNL, organised by us. The aforementioned European Agent System Summer School attracted 85 students at MSc and PhD level, and allowed our own student to attend international level courses, taught by 26 tutors. The EMCL's Students Workshop also took place in UNL, and attracted 40 EMCL students from from the 5 partner in the consortium.

Again related to education activities, several foreigner researchers gave lecture in the EMCL, and collaborated with CENTRIA members: Terrance Swift from mdlogix, Maryland, USA; Veronica Dahl, Simon Fraser University, Vancouver, Canada; Fabrizio Riguzzi, Ferrara University, Italy.

Several talks and seminars have been given by member of CENTRIA in this area, in Summer Schools, Scientific events and in other institutions and in Summer Schools. José Alferes made invited seminars on Semantic Web related topics in the University of New South Wales, Griffith Univeristy and The Australian National University; Gregory Wheeler gave a tutorial on Probabilistic Logic at the Indian Institute of Technology Winter Logic School, IIT Kanpur, an invited talk at Workshop on the foundations and applications of non-classical logics, De Giorgia Center for Mathematical Research, Scuola Normale Superiore, Pisa, and at the Seminar in Logic and Games Series in the City University of New York (CUNY) Graduate Center; Luís Moniz Pereira gave a course on "Computational Logic Applications in Cognitive Sciences" at the ICCL Summer School 2008, in Dresden; João Leite gave a tutorial at 5th International Conference on Autonomous

Agents and Multi-Agent Systems (AAMAS'08).

During the year of 2008 we have continued the study of the Extended Resource Description Framework (ERDF) [7, 31, 30]. The semantics is fully described in the JAIR paper [7] with complete proofs and theorems, as well as the relationship to the standard RDF for knowledge representation in the Semantic Web. The semantics is undecidable for the general case because of container membership properties, as it is shown in [31]. By imposing an upper limit to these membership properties, decidability is regained, with no practical limitation for the users [30]; complexity of several reasoning tasks is also analyzed. We recall that a major feature of ERDF is the possibility of representing explicitly negative information as well as absent information, allowing for the simultaneous definition of open and closed predicates. This is practically relevant as shown in [77] where ERDF is explored to represent several real examples using the Friend Of a Friend Vocabulary (FOAF), used to express information about individuals in social networks.

Structuring knowledge in a principled way is fundamental for the sharing of information in the Semantic Web. A formal framework for modular web rule bases has been proposed in [29]. This work defines for the first-time a model-theoretical semantics capable of integrating global and local knowledge in a sensible way, extending both Answer Set Semantics as well as Well-Founded semantics with Explicit Negation.

Related to the Semantic Web, we started work last year on semantics and on hybrid knowledge bases, including (non-monotonic) rules and (monotonic) ontologies have produced important results [60]. Preliminary work towards this goal was made in 2007 and a PhD thesis as started on this subject, co-supervised by Pascal Hitzler from the University of Karlsruhe. This work is of particular relevance for application in the context of the Semantic Web.

Also related to the Semantic Web the work developed by us in the Rewerse project consolidated in this last year of the project, with the stabilisation of the implementation of r3 framework for active rules in the Semantic Web over heterogeneous component languages, and its testing in applications. Namely, one application has been developed in web policies [27], and to bio.informatics [48], the latter one in the context of a MSc thesis. This work was developed in collaboration with the ISS area.

Related research was done aiming to propose new models for ontology mapping, using negotiation and argumentation frameworks. This work is described in more detail in section IIS.

The activities in 2008 also included work in (Dynamic) Knowledge Representation and Multi-Agent Systems. More focused in the area of (Dynamic) Knowledge Representation, further work was conducted on developing EVOLP namely by extending it with temporal operators [26] and developing a transformational semantics [72] which served as the basis for an implementation [71] (available at centria.di.fct.unl.pt/evolp). In what concerns the application of (Dynamic) Knowledge Representation mechanisms, we explored the use of the basic EVOLP in representing the state of an evolving institution in [94] and of its extension with temporal operators in representing the evolution of an agent [28]. We also explore the use of Answer-Set Programming to provide modular solutions to several Multi-Agent Resource Allocation Problems [92] and of Dynamic Logic Programming in representing user preferences in Recommender Systems [87, 54, 53]. Work on Multi-Agent System was also developed in specification and verification of agent properties, [44] and on learning agents [43].

The center's research contributions to uncertain reasoning continued in 2008. First, the Leverhulme funding PROGICNET project ended in April of 2008, and the research group spent the remainder of the year finalizing a book manuscript containing the results. The book has since been contracted by The Synthese Library, a Springer imprint, and is scheduled to appear toward the end of 2009 or beginning of 2010. Second, links between Carnegie Mellon and CENTRIA were strengthened as Richard Scheines visited CENTRIA in June to collaborate with Gregory Wheeler, and Wheeler visited CMU again in the fall of 2008 to work with Scheines, Kevin Kelly, and Horacio Arlo-Costa. Third, the ESF project *Philosophy of Science in Europe* was launched in April, and Wheeler has joined the editorial board of a Springer series by the same name and participates both as a member of the steering committee and a scientific contributor to the formal methods group.

In addition to these items, which continuations of the initiatives described in the 2007 re-

port, Wheeler also visited Medical Decision Logics (MD Logix) and The Johns Hopkins School of Medicine in Baltimore, Maryland, to promote collaboration between CENTRIA members and these two groups of clinical informaticians.

Regarding implementation of logic programming systems, a multi-threading extension to the GNU Prolog system was implemented, the outcome of which was Pedro Patinho's (pre-Bologna) MSc. thesis [93]. Also, a preliminary implementation of a probabilistic logic system in XSB prolog has been made, and was shortly described in the paper [32]. This allows for future work on the integration of probabilistic reasoning with ontologies, with important potential applications, namely to medical applications being explored by CENTRIA in collaboration with MD Logix.

On the more logical/mathematical side, in the context of the mentioned DiFoS project, there were results on Recursion Schemata for NC^k [35] and towards Reverse Proofs-as-Programs [59].

During 2008, research in the area of Inteligent Information Systems was done on the following topics: Data warehouses and integration of heterogeneous databases; tools for the semantic web; Ontologies; Intelligent agents for automatic classification of documents; natural language dialogue systems.

Derivatives of the ISCO language were used to produce semantic web-aware mediator systems, which can interface to the outside world via SPARQL and operate on OWL ontologies. Different aspects of this system were reported on, in three conference papers [63, 47, 62] and one journal article [13] and resulted in two (pre-Bologna) MSc. theses: Tiago Fernandes [81] and Nuno Lopes.

A Workflow modeling system was implemented on top of ISCO, being the body of the work of Rui Gamito's (pre-Bologna) MSc. thesis [84].

Cognitive Sciences Our activity continued in the areas connecting IIS to evolutionary psychology, with the two journal publications [15, 16], and lecturing on the subject in a summer school, viz. L. M. Pereira, "Computational Logic Applications in Cognitive Sciences", 5 one hour lectures at the ICCL Summer School 2008: Computational Logic and Cognitive Science (ICCL-SS-2008), TU Dresden, August/September 2008.

Research on Structural Bioinformatics Research on structural bioinformatics focused on the problem of modeling transient protein complexes. These are macromolecular structures formed by weak protein interactions, typically short lived and part of fast dynamic processes in vivo, such as enzymatic catalysis. The approach involves using one set of structures for each partner and assessing the models obtained by simulating the pairwise interactions across all combinations of structures. This results in a large set of models, typically on the range of hundreds of thousands of different structures, that is then evaluated under the assumption that the fast turnover of transient complexes requires a fairly broad and shallow depression on the interaction energy landscape. This should allow the identification of the most promising structure combinations and scoring functions for each case.

In parallel, the comparison of protein sequences from different organisms may help identify key residues in the interaction. If one of the protein partners suffers a mutation that replaces a amino acid residue that is important in the interaction, this will create a selection pressure for a compensatory mutation at the corresponding site on the other partner. The comparison of sequence pairs from different organisms, either by mutual information measurements or by estimates of interaction propensity, should reveal such correlations in some mutations and pinpoint important residues, which in turn can provide constraints that help guide the docking simulations. A review article on the application of constraints to structural bioinformatics was published on the Constraints journal [8].

Work also progressed on the integration of bioinformatics data and web services, with the implementation of a prototype system for event-condition-action rules that respond to updates to the Protein Data Bank. This was part of the MsC dissertation work by Tiago Gama Franco, and was also published at the SWATLS4 workshop in Edinburgh [48].

Ontology mapping. The proposed approach is based on a multi-agent argumentation framework with confidence degrees. Two articles in journals and four articles in international conferences were produced.

In addition, a project aiming to develop medical ontologies – MEDON – was approved by FCT, starting in January 2009.

Question-Answering systems. We continue to develop a system that uses clarification dialogues in order to disambiguate the possible meaning of user questions in natural language. The system will only query the user when commitment to some meaning is relevant for the final answer. When there are multiple different answers to a user query, the system initiates a clarification dialogue trying to ascertain the user's intentions. The clarification question is always about a relevant property of a (user) discourse entity. The answer to the clarification question (its semantic representation) can be incorporated into the initial user question enabling its reinterpretation under the new constraints.

This is developed in an integrated logic programming framework, based on Constraint Logic Programming using the GNU Prolog/CX language and the ISCO framework. The use of this LP framework allows the integration of Prolog-like inference mechanisms with classes and inheritance, constraint solving algorithms and provides a connection with relational databases, such as PostgreSQL. Luis Quintano thesis reports part of this work. We now are working on the representation and interpretation of natural languages queries using generalize quantifiers and finite domain varibles to represent discourse entities.

A question-answering system specialized for the Portuguese language is being developed and evaluated at CLEF – Cross Language Evaluation Forum. The 2008 results showed improvements over the previous years and two conference articles were produced.

Text classification with Support-Vector Machines. The use of linguistic structures as input of SVM was proposed and evaluated. Semantic information represented as graphs showed to be a good alternative to the more standard bag of words model. Two conference articles were produced.

RuleML . The RuleML initiative defines a normalized markup for expressing and exchange rules in the Semantic Web. However, the syntax of the language is still limited and lacks features for representing rule-based languages capable of handling uncertainty and vagueness. It is desirable to have a general extension of RuleML which accommodates major existing languages proposed in the latest two decades. The work [11] proposes such a general extension, showing how to encode many of the existing languages, with special attention to the important case of fuzzy rule languages.

The preliminary implementation of a probabilistic logic system in XSB prolog has been shortly described in the paper [32]. This allows for future work on the integration of probabilistic reasoning with ontologies, with important potential applications, namely to medical applications being explored by CENTRIA in collaboration with MDLogix.

2.2 Soft Computing and Constraints

Research on Constraint Programming was carried out in 2008 along several different directions. Francisco Azevedo started the CENTRIA participation in project AutoDynAgents), co-ordinated by our colleagues in GECAD, together with a new M.Sc. student, João Martins. In addition the research on graph constraints has lead to his successful supervision of the M.Sc. thesis by Ruben Viegas. The continuation of their work on the Grasper graph solver has led to the successful submissions of a journal and a workshop papers, both due in 2009. In addition to the specific work on Grasper, a study of better encodings of structured domains such as graphs and sets, on the platform Casper (that is being developed as part of Marco Correia PhD research) has been presented at Iberamia [76]. A new interface for the Casper platform was developed so that it could compete in the Constraint Solvers competition, where it was classified in second place in one of

the categories that it was targeted for (see full results in http://www.cril.univ-artois.fr/CPAI08/). In addition to some cleaning of the coding, the platform is now able to include several advanced heuristics developed by colleagues (such as dom/wdeg and impact) as well as a new look-ahead heuristics that we have been developing and shown to be more efficient than the others in some classes of problems (e.g. latin squares [41, 40]) Other heuristics that can be considered are those resulting from knowledge compilation, of which some initial research was carried out in the MSc theses of Jean Jung [88, 57] and Valentin Mayer-Eichberger [91].

In constraints over continuous domains, a probabilistic continuous constraint framework has been developed that combines continuous constraint reasoning with probabilistic reasoning [38]. Uncertainty, usually represented by intervals of possible values, can be further characterized in this framework by probability distributions distinguishing between different possible scenarios based on their likelihoods. The suitability of such framework for decision support have been studied in several nonlinear continuous problems with uncertain information. Inverse problems and reliability problems were identified as representative of the kind of reasoning required by the decision makers that might benefit from the approach. The probabilistic framework was successfully applied to inverse problems [37]. Such problems aim at estimating parameters from observed data, based on some underlying theory about some system behaviour. The probabilistic framework is also an adequate tool to model reliability problems since it combines feasibility with probability. These ideas were the subject of a presentation in the doctoral program of CP 2008 by Elsa Carvalho.

In the context of structural bioinformatics, work was consolidated in the area of prediction of protein structure and protein interaction, integrating information obtained from Nuclear Magnetic Resonance and other types of constraints (for the interactions) [8]. The application of constraints solving in the area of structural bio-informatics has led to an invitation to publish a survey article in this topic due in 2009. Research on structural bioinformatics has advanced towards the modelling of transient protein complexes. These are macromolecular structures formed by weak protein interactions, typically short lived and part of fast dynamic processes in vivo, such as enzymatic catalysis. The approach involves using one set of structures for each partner and assessing the models obtained by simulating the pair wise interactions across all combinations of structures.

In parallel, the comparison of protein sequences from different organisms may help identify key residues in the interaction. The comparison of sequence pairs from different organisms (either by mutual information measurements or by estimates of interaction propensity), should reveal such correlations in some mutations and pinpoint important residues, which in turn can provide constraints that help guide the docking simulations. Work also progressed on the integration of bioinformatics data and web services, as previously reported in the IIS section.

Still in bioinformatics applications, Olivier Perriquet has been developing new fast software for RNA secondary structure prediction, based on the improvement of heuristics on a set of recursions discovered by Sankoff, who pioneered the field. A beta version is already available online, while several international communications and papers are ongoing (2009). Discussions also started on how to integrate constraints into that framework.

It is worth mentioning some original reflexions around game and play that Olivier Perriquet has been carrying out, with a special focus on art / science relationship. Beyond his artistic production, he also started this year to lecture on these topics in the academic field, which may also expand the reputation of CENTRIA in these trans-disciplinary areas. In particular, he has attended and lectured in two workshops held in France (Castle of Bostz, and École des Beaux-arts de Nancy) and exposed his artistic work in four events. A tighter related connection to Artificial Intelligence and Game playing is the combinatorial game ALPHA that he invented and which was awarded the first prize at the international competition of the CNJ (Centre National du Jeu) in Paris. The game was ported online.

Initial work on the IBM Cell/BE processor to support declarative programming models was carried out. A first hybrid prototype, mixing constraint propagation and local search techniques was developed and benchmarked. The outcome of this work is described in Rui Machado's (pre-Bologna) MSc. thesis [89].

This work started to be carried out in collaboration with the INRIA RUNTIME project, hosted at the University of Bordeaux-I LaBRI laboratory, within the framework of the CONTEMP project.

Moreover, the parallel execution of constraints or local search techniques is being the object of a new collaboration with Daniel Diaz of the University of Paris-I (France) and Philippe Codognet of the JFLI laboratory, hosted at Keio University (Japan).

Work on applying Constraint Programming to computer network monitoring and diagnostic as started, being the focus of Pedro Salgueiro's PhD. work. The experimental work initially relies on Gecode/R, as this framework provides a convenient means of defining Domain-Specific Languages, which are also key to this researcher's work.

The work on Soft Computing has consolidated previous research in this area carried out in CENTRIA with a main focus on oceanographic applications.

In the framework of project LSTOP, an unsupervised fuzzy clustering method, Anomalous Pattern-Fuzzy Clustering (AP-FCM), is proposed and experimentally tuned to segment upwelling regions from Sea Surface Temperature (SST) images. Features extracted from the AP-FCM segmentation, taking into account domain-knowledge about 'upwelling front', support the characterization and automatic annotation of upwelling fronts within the SST images. A preliminary study has been conducted concerning the identification of fuzzy boundaries in an attempt to spatially characterize transition zones between upwelling regions. Quantitative and visual assessment of the AP-FCM results over a large set of SST upwelling images provides evidence for the effectiveness of this tool for the automatic identification and annotation in upwelling studies.

Still in this project, the previous eddy detector based on ellipse centre accumulation was improved and by using only one bi-dimensional accumulator in combination with ellipse fitting to determine the ellipse parameters, this way minimising problems associated to the use of accumulators. Our research showed that our new ellipse detector outperforms the typical state-of-the-art detectors which use three accumulators, two bi-dimensional and one uni-dimensional [46]. In addition, a new method for eddy detection employing orientation fields was created, which is a major innovation in that other similar methods cannot be applied to our images and are conceptually more complex. In our new method, the orientation field is extracted from a binary image that is determined by adopting a threshold on the iterative average of the gradient values of the nearest neighbours of each image pixel. Our research also led to the creation of a new method to determine the parameters of an ellipse that encloses the regions with water circulation. Contrary to previous works found in scientific literature, this new method does not depend on any scale factors set ad-hoc by the system user [45].

Davide D'Alimonte's research work of 2008 focused on different remote sensing (RS) oceanographic applications. Related to the analysis of the sea-surface temperature (SST), a novel Model for identifying Eddy-Related Structure from Iso-SST pattern (MERSI) was developed to account for the complex dynamics characterizing the Ocean off the coast of Portugal. Results, obtained in the framework of the project *Learning Spatio-Temporal Oceanographic Patterns*—LSTOP (contract PDCT/EIA/68183/2006), were presented at the workshop "Ciência 2007" hold at the Rectorate of the "Universidade Nova de Lisboa", and accepted for publication (D'Alimonte, D., Detection of Mesoscale Eddy-Related Structures Through Iso-SST Patterns. IEEE Geosc. Rem. Sens. Lett., 2009, 6, 189-193).

At the same time, investigations have been undertaken in the Ocean Color (OC) RS domain. It is recalled that OC allows for retrieving the concentration and optical properties of the so called optically significant seawater components. The Chlorophyll-a concentration, generally used as a proxy for biomass concentration, is the most known OC product and it is exploited in climate change studies and water quality monitoring. Studies about the validation of satellite observations and derived products were presented at workshops (Ocean Optics XIX, Barga, Italy, October 2008; and MERIS User Workshop ESA/ESRIN, Frascati, Italy, September 2008) as well as in peer-reviewed journals (D'Alimonte, D.; Zibordi, G. and Mélin, F., Statistical Method for Generating Cross-Mission Consistent Normalized Water-Leaving Radiances. IEEE Trans. Geosc. Rem. Sens., IEEE, 2008, 46, 4075-4093; and Zibordi, G.; Mélin, F. and D'Alimonte, D. An Evaluation of Radiometric Products from Fixed-Depth and Continuous In-Water Profile Data from Moderately Complex Waters. J. Atmos. Oceanic Technol., 2008, 26, 91-106). Two additional papers have also been accepted for peer-reviewed publications ["Remote Sensing of Environment" (Elsevier) and "Journal of Atmospheric and Oceanic Technology" (AMS)].

In view of extending the above investigations, two proposal were submitted to the "Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa" (FCT/UNL). One proposal is in partnership with the "Centro de Informática e Tecnologias da Informação" (CITI/FCT/UNL) with the scope of developing a Monte Carlo code for simulating the radiative transfer in the seawater medium (Ref.: PTDC/CCI-CIN/103107/2008). The other proposal, a joint effort between "Instituto de Oceanografia" (CO/FC/UL), CENTRIA, CITI and the "Institute for Environment and Sustainability of the Joint Research Centre", European Commission (JRC-IES), is about the bio-optical characterization and validation of ocean color satellite observations in the coastal waters of Portugal (Ref.: PTDC/MAR/101615/2008). Finally, a third proposal was submitted (in collaboration with CITI) to the European Space Agency (ESA) to provide the technical assistance for the validation of MERIS marine products at several European coastal basins (Ref.: ESRIN/RFQ/3-12595/09/I-OL).

In other soft computing application area, in the framework of the project COPSRO, an electronic survey tool (ESSA), was developed for data collection about the scientific activities of members of academic organizations, which refers to topics of Computer Sciences represented by nodes of the ACM-CCS ontology (the tool is available at https://copsro.di.fct.unl.pt/). A new method, cluster-lift, has been introduced to involve two generalization steps: one on the level of individual activities clustering and the other on the concept structure level lifting. An additive clustering method ADDI-S by the authors has been experimentally tuned to deal with the survey's data. A novel additive fuzzy clustering method for treating ESSA results has been proposed.

Work on Neural Networks has continued, namely by pursuing results in neuro-symbolic (NeSy) learning and in self-organized maps (SOM). During 2008, the M.Sc. thesis by Bruno Silva on Parallel Self-Organizing Maps was concluded with quite interesting results and a Java prototype (Net Som) is now operational and will constitute a major asset for future work in this area. Work with former Post-doc researcher Marco Castellani on FeSANNT was published in 2008 ([9]). Further work on SOM will also address work with Chen Ning (a former CENTRIA post-doc researcher, now working in GECAD), namely the extension of NCSOM (Numerical Categorical SOM) to LVQ: a paper was submitted during 2008, to be presented on a 2009 conference.

Nuno Marques has spent part of his sabbatical leave in TU-Dresden working jointly with Steffen Holldobler. Original goals of this work focused mainly on applying the NeSy approach, originally presented by Holldobler and Kalinke in 1994, to the neuronal part-of-speech text-mining classifier originally developed during Nuno Marques's PhD. This work revealed the need of updating the training process to include further domain knowledge [33] and triggered more applied work and further cooperation in application areas. Specifically, in collaboration with CLUNL (the linguistics group at FCSH/UNL), we started work on the neuronal part-of-speech tagger (based on earlier work started by Marques and Lopes in 1996). Also, in collaboration with the industrial partner Vortal, Júlio Barbas defended an M.Sc. thesis in 2009. Joint application of all this results to the TOURS-PLAN project will also be possible since the joint cooperation tasks in this project were delayed to 2009.

3 List of ongoing projects in 2008

Name	LSTOP - Learning Spatio-Temporal Oceanographic Patterns
Status	Ongoing (start February 2008, end January 2011)
Funding Institution	Fundação Ciência e Tecnologia (MCTES) PTDC/EIA/68183/2006
Principal researcher	Susana Nascimento
CENTRIA Participants	Armando Fernandes, Nuno C. Marques
Description	The main objective of this project is the development of Machine Learning methods for the automatic identification, analysis and prediction of oceanographic mesoscale phenomena in the Iberian Coastal Ocean (eddies, upwelling and coastal counter-current), including their spatio-temporal evolution, from remote sensing images. Dynamic versions of fuzzy clutstering will be investigated in the identification and tracking of these phenomena, and knowledge-aware neural networks will be studied for their classification and prediction incorporating domain knowledge.

Name	COPSRO - Computational Approach to Ontology Profiling of Scientific Research Organisations
Status	Ongoing (start January 2008, end December 2010)
Funding Institution	Fundação Ciência e Tecnologia (MCTES) PTDC/EIA/69988/2006 (146.837,00 EUR)
Principal researcher	Susana Nascimento
CENTRIA Participants	Luís Moniz Pereira
Description	The main objective of this research work is to develop a methodology for ontology profiling scientific research organisations, including: 1.A reliable and valid research subject extraction method developing text mining techniques. 2.An effective method for establishing within-organisation similarities between the ontology items. 3.Adequate clustering methods for representing a research organisation by a set of possibly overlapping or fuzzy subject clusters. 4.Optimally mapping the subject clusters to the subject area ontology to reveal organisationâs âhead subjectsâ, âmissing subjectsâ and âsubject gapsâ. 5.Interpretation and evaluation of individual organisation profiles. 6.Combining individual organisation profiles into an aggregate profile. 7.Characterization of aggregate profiles by rule extraction. 8.Experimental verification of the method. The proposed methodology will be applied to scientific research organisations of computer science, specifically, Computer Science (CS) departments of Universities in Portugal and UK, having as ontology of reference the ACM Classification System (http://www.acm.org/class/1998/ccs98.html).

Name	CONTEMP - CONTraintes Exécutées en MultiProcesseurs
Status	Ongoing (start January 2008, end December 2010)
Funding Institution	GRICES/EGIDE
Principal researcher	Salvador Abreu
CENTRIA Participants	Lígia Ferreia, Pedro Barahona, Ludwig Kripphal
Description	This project involves the RUNTIME team at Univ. of Bordeaux-I/INRIA and will promote cooperation in parallel execution of constraints on hierarchical multiprocessors.

Name	Design and implementation of an architecture for interactive, cognitive virtual characters
Status	Ongoing (start January 2008, end December 2009)
Funding Institution	KK stiftelse KK-stiftelse (300000 SEK)
Principal researcher	Pierangelo DellâAcqua
Description	We consider virtual, autonomous characters situated in dynamic, unpredictable, virtual worlds. To render these characters self-animated (i.e., alive) in real time performances, we need to make them able to perceive, reason and act in the world where they are situated. This goal can be achieved by ascribing characters cognitive capabilities together with reactive functionalities. The focus of this proposal is to deploy state-of-the-art artificial intelligence ethods into character simulation and extract and address new research issues in computer graphics and artificial intelligence in the context of the developed applications. The specific aims of the project are to develop: - a model for perception and action, that is a model to couple the virtual world and the mental state of the characters. - a model of an architecture (for characters) combining high-level cognitive capabilities with lowlevel reactive functionalities. - an implementation of the characterÂś architecture.

Name	JEDI - A Joint Environment for Deduction and Induction
Status	Ongoing (start January 2008, end December 2010)
Funding Institution	Fundação Ciência e Tecnologia (MCTES)
Principal researcher	Salvador Abreu
Description	TBD

Name	STAMPA - Sophisticated TAbling Mechanisms for Prolog and their Applications
Status	Ongoing (start January 2008, end December 2010)
Funding Institution	Fundação Ciência e Tecnologia (MCTES)
Principal researcher	Salvador Abreu
Description	TBD

Name	SSTEddy - Eddy detection
Status	Ongoing (start January 2008, end December 2011)
Description	This project is an approach to develop fuzzy clustering methods and their extension to dynamic versions, for the automatic identification, analysis and tracking of oceanic mesoscale phenomena in the Iberian Coastal Ocean. Knowledge aware neural networks will also be studied for classification and prediction of these phenomena by incorporating domain knowledge. Specifically, we are going to study the application of these methodologies to the presence of eddies, coastal upwelling and a coastal counter-current off Iberia, including their spatio-temporal evolution, from satellite remote sensing images.
Results	Identifying mesoscale eddy-related structures from remote sensing (RS) images of the sea surface temperature (SST) off the Portugal coast is a complex task due to the Ocean dynamics of this region. Here, upwelling currents and bathymetry effects produce countless and highly heterogeneous SST patterns, features of interest may have smooth boundaries, as well as edges associated to strong temperature gradients may not correspond to any eddy. All this limits the effectiveness of an image processing based on edge-features (which can be successfully applied to automatically detect eddies in other oceanographic areas, for instance close to the Gulf Stream). The scope of the present report is documenting the work progress performed in 2008 (LSTOP project under Grant PTDC/EIA/68183/2006) to implement a new Model for identifying Eddy-Related Structure from Iso-SST pattern (MERSI). The novelty of the MERSI scheme is the exploitation of iso-SST patterns associated to the eddy-related structure to code with a rule-based definition the process that allows for their visual identification (knowledge-based approach). In practice, this enables revealing various morphological parameters of the eddy-related structure (i.e., the location, scale, symmetry and rotation). A software application called SEAEDDY has been build on top of the MERSI scheme to enable interactive functionalities. SEAEDDY provides access to reference information valuable to improve the exploitation of SST data allowing for annotating the RS image and benchmarking the subjectivity of the visual survey.

Name	PSE - The Philosophy of Science in a European perspective - ESF networking Programme
Status	Ongoing (start 2008, end 2013)
Funding Institution	European Science Foundation
Principal researcher	Gregory Wheeler
Description	In the beginning of the last century an important European tradition of investigations into the nature of scientific knowledge took definitive shape. This development comprised a wide range of different disciplines and a number of different European countries. It included renowned scientists, such as Ernst Mach, Ludwig Boltzmann, Carl Menger, Ludwig and Richard von Mises, Otto Neurath, Albert Einstein, Max Planck, Pierre Duhem, Henri Poincaré, Karl Pearson, to mention but a few, and involved not only empirical disciplines, but formal ones too (David Hilbert, Kurt Gödel, Federigo Enriques, Jan Åukasiewicz, Alfred Tarski, Bertrand Russell). This scientific and philosophical movement, involving but not confined to Central Logical Empiricism in Vienna, Berlin and Prague, was strongly interdisciplinary and cross-disciplinary. It produced an extensive and stimulating literature and prepared the ground for a wide array of reflections on the structure of science, its aims and limits. It is our aim to rekindle and reinforce this European tradition in the philosophy of science.

Name	TOURSPLAN - TOURS PLANning Support system
Status	Ongoing (start December 1st 2007, end November 30 2010)
Funding Institution	GECAD (ISEP) PTDC/EIA/74310/2006 (95000EUR)
Principal researcher	Nuno C. Marques
Description	Nowadays personalization is becoming one of the main requisites of tourism sector. A step toward this personalization is achieved through this project. It focuses on personalised tour planning, based on route planning algorithms and recommendation techniques integration. The following goals are envisaged in the project: 1) Tourism domain knowledge base modelling through the use of ontologies or concept graphs, including sights, transportation and users profiles. 2) Recommendation strategies considering adaptive content selection based on context and user interest modelling can be an effective way to select information, giving to tourist a high level of personalisation. 3) Route planning algorithms can combine places of interest with transportation alternatives and schedules, resulting in detailed planned itineraries for the personalised tour plans previously generated. 4) The use of the adaptive hypermedia through adaptive presentation can improve content understanding turning the system more attractive, adapting better to its users.

Name	AutoDynAgents - Autonomic Agents with Self-Managing Capabilities for Dynamic Scheduling Support in a Cooperative Manufacturing System
Status	Ongoing (started February 16 2007)
Funding Institution	Fundação Ciência e Tecnologia (MCTES) PTDC/EME-GIN/66848/2006 (80000EUR)
Principal researcher	Luís Moniz Pereira
Description:	`http://www.gecad.isep.ipp.pt/Gecad/Projectos/ViewProj/?IdProj=56`

Name	IBM-SUR - Parallel and Distributed Computational Models for Scientific Applications on Cell Processor Clusters
Status	Ongoing (started 2007)
Funding Institution	IBM Corp. International
Principal researcher	Salvador Abreu
CENTRIA Participants	Luís Moniz Pereira, Armando Fernandes, Carlos Damásio, Francisco Azevedo, Irene Rodrigues, Lígia Ferreia, Pedro Barahona, Susana Nascimento
Description	The research groups of CENTRIA and CITI are involved in several projects which will benefit from the resources which will be allocated as a result of the present proposal. In the scope of this SUR application, we specifically target the following areas: Computer Science Concepts & Technologies - Constraint Programming and Parallel and Distributed Computing (including Cluster & Grid) - in particular, this includes Constraint Execution in multi-Cell clusters. Application areas: Bioinformatics and Life Sciences and Earth, Sea and Space research. For the current SUR proposal the main focus is the development of techniques and tools which may effectively draw on the potential of hierarchical parallel computing infrastructures, which goes from heterogeneous multicore processors such as the Cell to cluster systems. This goal is achieved by exploiting computational models well suited to the architecture.

Name	PROGICNET - Probability Logic and Probabilistic Networks
Status	Finished (started April 2006, ended April 2008)
Funding Institution	The Leverhulme Trust
Principal researcher	Gregory Wheeler
Description	The study of a unified framework for probability logics.
Results	Accepted proposal.

Name	KRENI - Knowledge Representation with Negative Information
Status	Finished (started January 2006, ended January 2008)
Funding Institution	Council of Rectors (CRUP)
Principal researcher	Luís Moniz Pereira
CENTRIA Participants	José Alferes
Description	The study of the negative information, its formalization and the way of representing and implementing this information in Logic Programming.
Results	Accepted proposal.

Name	PRECISE - in Science and Engineering
Status	Finished (started April 2005, ended March 2008)
Funding Institution	Fundação Ciência e Tecnologia (MCTES) POSI/EIA/59786/2004
Principal researcher	Pedro Barahona
CENTRIA Participants	Jorge Cruz
Description	This project aims at a) investigating possible ways of introducing probabilities (or mere likelyhoods) in the continuous constraint framework; b) developing extensions to our previous work in constraint propagation techniques in continuous constraints to address this extended framework; and c) Evaluate and validate this research, in a number of applications, namely biomedical and engineering.

Name	International M.Sc. Program in Computational Logic
Status	Ongoing (start September 2004, end September 2009)
Funding Institution	EU Erasmus Mundus
Principal researcher	Luís Moniz Pereira
CENTRIA Participants	José Alferes, João Leite
Description	One major activity was to setup and launch a joint distributed european MSc degree in Computational Logic with 4 other partners, initiated in the context of project CoLognet. This involved the creation of a new MSc in Computational Logic at UNL. Cf.
Results	Project continued in academic years 04/05 and 05/06. Several coordinating meetings. Yearly report.

Name	REWERSE - Reasoning on the Web with Rules and Semantics
Status	Finished (started March 1st 2004, ended March 1st 2008)
Funding Institution	EU-IST
Principal researcher	Luís Moniz Pereira
CENTRIA Participants	José Alferes, Carlos Damásio, Pedro Barahona, Ludwig Kripphal, Ricardo Amador
Description	REWERSE strives for advanced Web systems and applications sometimes referred to as Semantic Web, a term coined in 2001 by Tim Berners-Lee et. al. in the article âThe Semantic Webâ in Scientific American. This term refers to one of the major current endeavours world wide in Information Technologies. Its goal may be briefly described as enriching the existing Web with meta-data and data processing (and meta-data processing) so as to provide Web-based systems with advanced (so-called intelligent) capabilities, in particular with context-awareness and decision support, strengthening a person centred, everyday use of the Web.
Results	Meetings, deliverables, and publications, in the area of our responsibility for Working Group Evolution and Reactivity. And according to participation in WGs Education and Training, Rule Markup Languages, Towards a Bioinformatics Semantic Web, and Personalised Information Systems.

4 List of Ph.D. students and topics in 2008

Completed MSc. thesis are now presented in section 5, under publications.

Name	Teresa Gonçalves
Degree	Ph.D.
Supervisor	Paulo Quaresma
Topic	Automatic Classification of Portuguese Documents
Start date	October 2003
Finish date	January 2008

Name	Federico Banti
Degree	Ph.D.
Supervisor	José Alferes
Topic	A language for executing and reasoning about evolution of logic based agents
Start date	October 2003
Finish date	for February 2008

Name	João Fernando Lima Alcântara
Degree	Ph.D.
Supervisor	Carlos Viegas Damásio and Luís Moniz Pereira
Topic	Paraconsistent Disjunctive Extended Logic Programs
Start date	September 2001
Finish date	September 2008

Name	Alexandre Miguel Pinto
Degree	Ph.D.
Supervisor	Luís Moniz Pereira
Topic	Ontologia para linguagens de especificação de acçĩntencionais para regras reactivas
Start date	September 2005
Finish date	August 2009 (expected)

Name	José Saias
Degree	Ph.D.
Supervisor	Paulo Quaresma
Topic	Automatic construction of ontologies and their application in the semantic web context
Start date	October 2004
Finish date	2009 (expected)

Name	Ana Luisa Leal
Degree	Ph.D.
Supervisor	Paulo Quaresma
Topic	Rhetorical Structures and Question Answering Systems
Start date	October 2004
Finish date	2009 (expected)

Name	Cássia Santos
Degree	Ph.D.
Supervisor	Paulo Quaresma
Topic	A Multi-Agent Architecture for Question-Anwering
Start date	October 2005
Finish date	2009 (expected)

Name	Vítor Nogueira
Degree	Ph.D.
Supervisor	Salvador Abreu and Gabriel David (Faculty of Engineering, University of Porto)
Topic	Constraint and Logic Languages for Hetherogeneous Database Systems
Start date	October 2001
Finish date	May 2009 (expected)

Name	Valeria Magalhães Pequeno
Degree	Ph.D.
Supervisor	João Moura Pires
Topic	Specification, maintenance and implementation of materialized object views in an object-relational data warehouse
Start date	July 2005
Finish date	2010 (expected)

Name	Luis Quintano
Degree	Ph.D.
Supervisor	Irene Pimenta Rodrigues
Topic	Natural Language Dialogues for IR from BD
Start date	October 2003
Finish date	2009 (expected)

Name	Marco Vargas Correia
Degree	Ph.D.
Supervisor	Pedro Barahona
Topic	Advanced Techniques for Improving Constraint Solving in Finite Domains
Start date	October 2004
Finish date	2009 (expected)

Name	Mário Abrantes
Degree	Ph.D.
Supervisor	Luís Moniz Pereira
Topic	Computational Logic semantics of contradiction removal
Start date	September 2005
Finish date	December 2010 (expected)

Name	Matthias Knorr
Degree	Ph.D.
Supervisor	José Alferes
Topic	Combining open and closed world knowledge representation for reasoning on the semantic web
Start date	September 2006
Finish date	March 2010 (expected)

Name	Ricardo Amador
Degree	Ph.D.
Supervisor	José Alferes
Topic	Web Integrated Development tools for Evolution and Re- activity.
Start date	September 2006
Finish date	2010 (expected)

Name	Carlos Filipe Freitas
Degree	Ph.D.
Supervisor	José Alferes
Topic	Geração de ideias em ambientes inteligentes de decisão.
Start date	September 2007
Finish date	2010 (expected)

Name	Martin Slota
Degree	Ph.D.
Supervisor	João Leite
Topic	Updates of ontologies with Rules.
Start date	September 2007
Finish date	2011 (expected)

Name	Orlando Sousa
Degree	Ph.D.
Supervisor	João Leite
Topic	Extração de Conhecimento Simbólico de Redes Neuronais Artificiais Aplicadas a Estratégias e Táticas de Negociação em Mercados Financeiros.
Start date	September 2007
Finish date	2011 (expected)

Name	Elsa Cristina Batista Bento Carvalho
Degree	Ph.D.
Supervisor	Pedro Barahona & Jorge Cruz
Topic	Integration of Guaranteed and Preferred intervals in Constraint Programming over Continuous Domains
Start date	October 2006
Finish date	October 2009 (expected)

5 Publications

5.1 Edited books and journal special issues

[1] Helena Barbas. *Madalena - História e Mito*, volume 1. Ésquilo - Edições e Multimédia, Av. António Augusto de Aguiar, 17, 4 E Lisboa, May 2008. Published simultaneous in Spain - "María Madalena" - with foreword by Prof. Jesús Callejo.

[2] Mehdi Dastani and João Alexandre Leite, editors. *Proceedings of the 10th European Agent System Summer School (EASSS'08), Lisbon, Portugal, May 2008*. FBA, 2008.

[3] Mehdi Dastani, A. El F. Seghrouchni, João Alexandre Leite, and Paolo Torroni, editors. *Languages, Methodologies and Development Tools for Multi-Agent Systems, First International Workshop, LADS'007, Durham, UK, September 4-6, 2007. Revised Selected Papers.*, volume 5118 of *Lecture Notes in Artificial Intelligence*. Springer, 2008.

[4] Esra Erdem and João Alexandre Leite, editors. *Proceedings of the Twelfth International Workshop on Non-Monotonic Reasoning session on Declarative Programming Paradigms and Systems for NMR*, volume UNSW-CSE-TR-0819. University of New South Wales, September 2008.

[5] José Carlos Ramalho, João Correia Lopes, and Salvador Abreu, editors. *XATA2008 — XML: Applications and Associated Technologies*. Univ. Minho, February 2008.

[6] A. Teixeira, V. Lima, C. Oliveira, and Paulo Quaresma, editors. *Computational Processing of the Portuguese Language, Propor 2008, Aveiro, Portugal, September 8-10, 2008, Proceedings*, volume 5190 of *Lecture Notes in Computer Science*. Springer, 2008.

5.2 In International Journals

[7] Anastasia Analyti, Grigoris Antoniou, Carlos Viegas Damásio, and Gerd Wagner. Extended rdf as a semantic foundation of rule markup languages. *Journal of Artificial Intelligence Researce (JAIR)*, 32:37–94, 2008.

[8] Pedro Barahona and Ludwig Krippahl and. Constraint programming in structural bioinformatics. *Constraints*, 13(1-2/June 2008):3–20, June 2008.

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5.5 Theses

[78] João Alcântara. *Paraconsistency, disjunction, and uncertainty in Logic Programming: a unifying approach based on the WFS*. PhD thesis, Universidade Nova de Lisboa, September 2008. Luís Moniz Pereira and Carlos Viegas Damásio (superv.);.

[79] Teresa Amaro. A construção de si - ana teresa pereira e a escrita como edificação de um universo literário e cultural. Master's thesis, FCSH-UNL, February 2008. Helena Barbas (superv.); This thesis got the final mark of 17/20.

[80] Federico Banti. *Evolving Reactive Logic Programs*. PhD thesis, Universidade Nova de Lisboa, February 2008. José Júlio Alferes (superv.);.

[81] Cláudio Fernandes. X.p.t.o. - a system for representing and querying semantic web ontologies. Master's thesis, Universidade de Évora, March 2008. Salvador Abreu (superv.);.

[82] Patrícia Ferreira. Repositórios e o livre acesso ao conhecimento científico: Estudo comparativo. Master's thesis, Universidade de Évora, July 2008. Paulo Quaresma (superv.);.

[83] Alice Freitas. Criação da biblioteca digital do fundo de periódicos do icbas: Estudo de caso. Master's thesis, Universidade de Évora, July 2008. Paulo Quaresma (superv.);.

[84] Rui Gamito. Workflow modeling using uml, declarative tools and web2.0. Master's thesis, Universidade de Évora, October 2008. Salvador Abreu (superv.); pre-bologna thesis.

[85] Marta Gomes. Implementação de políticas de indexação e metodologia para construção de tesauros. estudo de caso sobre o arquivo municipal de lisboa. Master's thesis, Universidade de Évora, November 2008. Paulo Quaresma (superv.);.

[86] Teresa Gonçalves. *Utilização de informação linguística na classificação de documentos em Língua Portuguesa*. PhD thesis, Universidade de Évora, January 2008. Paulo Quaresma (superv.);.

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[88] Jean Christoph Jung. Value orderings based on solution counting. Master's thesis, FCT/UNL, October 2008. Pedro Barahona (superv.);.

[89] Rui Machado. Constraint programming in a hetherogeneous multicore architecture. Master's thesis, Universidade de Évora, March 2008. Salvador Abreu (superv.);.

[90] Francisco Matias. Metodologias de qualidade e testes de data warehouses - sua importância para a flexibilização e optimização do processo de data warehouse. Master's thesis, Universidade de Évora, November 2008. Paulo Quaresma (superv.);.

[91] Valentin Mayer-Eichberger. Towards solving a system of pseudo boolean. Master's thesis, FCT/UNL, October 2008. Pedro Barahona (superv.);.

[92] Belopeta Mito. Multi-agent resource allocation with answer set programming. Master's thesis, Universidade Nova de Lisboa, October 2008. João Alexandre Leite and José Júlio Alferes (superv.);.

[93] Pedro Patinho. gprolog-mt: A parallel environment for gnu prolog. Master's thesis, Universidade de Évora, October 2008. Salvador Abreu (superv.); pre-Bologna thesis.

[94] Luca Quaglia. Evolving electronic institutions. Master's thesis, Universidade Nova de Lisboa, October 2008. João Alexandre Leite (superv.);.

[95] Luís Rosário. Resolução de anáforas e o seu impacto em sistemas de recuperação de informação. Master's thesis, Universidade de Évora, January 2008. Paulo Quaresma (superv.);.

[96] Bruno Silva. A study of a hybrid parallel som algorithm for large maps in data mining. Master's thesis, DI-FCT/UNL, December 2008. Nuno Marques (superv.);.

[97] Carla Sofia Silva. A questão da preservação digital numa perspectiva orientada segundo o open archival information system. Master's thesis, Universidade de Évora, July 2008. Paulo Quaresma (superv.);.

[98] Ruben Duarte Viegas. Constraint solving over finite graphs. Master's thesis, Universidade Nova de Lisboa, February 2008. Francisco Azevedo (superv.);.

6 Missions and Visitors

6.1 Missions

Francisco Azevedo

- Kaiserslautern, Germany, 22 September 2008 (4 days)
  Purpose: Participation in KI'2008 (31st Annual German Conference on Artificial Intelligence)
- Porto, Portugal, 01 October 2008 (1 days)
  Purpose: Startup meeting with GECAD partner on AutoDynAgents project

Ruben Viegas

- Lisbon, Portugal, 14 October 2008 (4 days)
  Purpose: Participation, with paper presentation, in IBERAMIA'2008
- Erice, Sicily, Italy, 08 September 2008 (9 days)
  Purpose: Participation in School on "Graph Theory, Algorithms and Applications"
- Lisbon, Portugal, 14 October 2008 (4 days)
  Purpose: Participation and paper presentation in The 11th edition of the Ibero-American Conference on Artificial Intelligence (IBERAMIA'08)

Helena Barbas

- University of Salzburg, Austria, 02 July 2008 (3 days)
  Purpose: Workshop - Human-Computer Interaction Methods in digital TV Applications
- University of West of England / Creative Media Practice and Research Group, England, 17 November 2008 (7 days)
  Purpose: To participate in the [b]Encounters-Short Film Festival[/b] and the conference [b]Narrative/Non-Narrative/Anti-Narrative[/b]

Nuno Marques

- TU-Dresden, Alemanha, 24 March 2008 (60 days)
  Purpose: Work as an invited researcher in Natural Language Processing and Neuro-Symbolic Systems.

Luís Moniz Pereira

- Madrid, Spain, 23 November 2008 (3 days)
  Purpose: IMDEA-Software Scientific Advisory Board and Board of Trustees meeting.
- Madrid, Spain, 22 June 2008 (3 days)
  Purpose: IMDEA-Software Scientific Advisory Board and Board of Trustees meeting.
- Dresden, Germany, 30 August 2008 (9 days)
  Purpose: To teach and participate in the ICCL Summer School 2008: Computational Logic and Cognitive Science (ICCL-SS-2008),âT̈U Dresden.

João Leite

- Barcelona, Spain, 29 January 2008 (3 days)
  Purpose: Review meeting of STREP IST — FP6-27253 Project OpenKnowledge.
- Amsterdam, The Netherlands, 12 December 2008 (3 days)
  Purpose: Review meeting of STREP IST — FP6-27253 Project OpenKnowledge.
- Guimarães, Portugal, 20 November 2008 (2 days)
  Purpose: Review meeting of ADI IDEIA Project AquaSmart.

- Dagstuhl, Germany, 31 August 2008 (6 days)
  Purpose: Participation in Dagstuhl Seminar 08361 on Programming Multi-Agent Systems where an invited talk was given.
- Sydney, Australia, 10 December 2008 (78 days)
  Purpose: Visiting Researcher at NICTA. Participation in ACM International Conference on on Web Intelligence and Intelligent Agent Technologies where two papers were presented.
- Estoril, POrtugal, 12 May 2008 (5 days)
  Purpose: Participation in 5th International Conference on Autonomous Agents and Multi-Agent Systems (AAMAS'08) where a tutorial was presented.

Gregory Wheeler

- Pisa, Italy, April 2008 (3 days)
  Purpose: Invited Talk: For the 1st Workshop on the foundations and applications of non-classical logics, De Giorgia Center for Mathematical Research, Scuola Normale Superiore.
- Madison, Wisconsin, USA, May 2008 (4 days)
  Purpose: Participation: The 5th Formal Epistemology Workshop (FEW 2008), University of Wisconsin, Madison.
- New York City, USA, October 2008 (1 days)
  Purpose: Invited talk: to the City University of New York (CUNY) Graduate Center, Seminar on Logic and Games Series.
- Carnegie Mellon University, Pittsburgh, USA, October 2008 (65 days)
  Purpose: Collaboration wtih Richard Scheines
- Kanpur, India, January 2008 (9 days)
  Purpose: Invited Lecturer: Winter School on Logic, Indian Institute of Technology (IIT-Kanpur)
- Granada, Spain, February 2008 (10 days)
  Purpose: PROGICNET final meeting
- Chicago, USA, April 2008 (4 days)
  Purpose: Participant: APA session on Formal Epistemology
- Strasbourg, France, May 2008 (3 days)
  Purpose: ESF steering committee meeting, project PSE
- Vienna, Austria, December 2008 (3 days)
  Purpose: ESF steering committee meeting, project PSE
- Baltimore, Maryland, USA, October 2008 (1 days)
  Purpose: Project proposal meetings at mdlogix and Johns Hopkins School of Medicine

Susana Nascimento

- Toulouse, France, 07 July 2008 (5 days)
  Purpose: participation in the 16th International Conference on Conceptual Structures, where she gave an oral presentation of the paper âRepresenting a Computer Science Research Organization on the ACM Computing Classification Systemâ
- SCSIS, Birkbeck, University of London, London, U.K., 07 August 2008 (5 days)
  Purpose: joint work with B. Mirkin in the framework of the COPSRO project.

José Júlio Alferes

- NICTA, Australia, 01 March 2008 (75 days)
  Purpose: Visit in the context of the collaboration under Action 3 of Erasmus Mundus

- Munich, Germany, 15 January 2008 (7 days)
  Purpose: Final review meeting of Rewerse project
- Rome, Italy, 15 February 2008 (2 days)
  Purpose: Review meeting of project Geopkdd
- Brussels, Belgium, 20 September 2008 (4 days)
  Purpose: Participation in evaluation of EU projects
- Dresden, Germany, 10 December 2008 (4 days)
  Purpose: Paticipation in a meeting of the European MSc. on Computational Logic.

6.2 Visitors

Werner Kriechbaum , IBM Böblingen R&D Centre, Germany. 2008-03-05 - 2008-03-07.
Give a seminar on the Cell/BE processor and participate in an MSc. jury.

Terrance Swift , None, USA. 2008-05-01 - 2008-05-31.
Teach Integrated Logic Systems in the EMCL and collaborate in LP research.

Terrance Swift , None, USA. 2008-11-25 - 2008-12-07.
Collaborate in LP research.

Veronica Dahl , Simon Fraser, Canada. 2008-02-23 - 2009-04-25.
Teach Integrated Logic Systems in the EMCL and collaborate in LP research.

Fabrizio Riguzzi , Ferrara, Italy. 2008-09-22 - 2008-09-30.
Teach Science of Computational Logic in the EMCL and collaborate in LP research.

Lotfi Boudjenah , Oran, Algeria. 2008-08-18 - 2008-08-28.
Collaborate in research in robotics.

Pierangelo Dell'Acqua , Linköping, Sweden. 2008-06-19 - 2008-07-25.
Collaborate in KRR and LP research.

Robert Kowalski , Imperial College, United Kingdom. 2008-04-05 - 2008-05-10.
Collaborate in KRR and LP research. Advise, as member of CENTRIA Advisory Board.

Isabel Cruz , Illinois at Chicago, USA. 2008-12-22 - 2008-12-22.
To gather information about research in CENTRIA.

Yohanes Stefanus , Indonesia, Indonesia. 2008-03-01 - 2008-04-01.
Teach Advanced Logics in the EMCL.

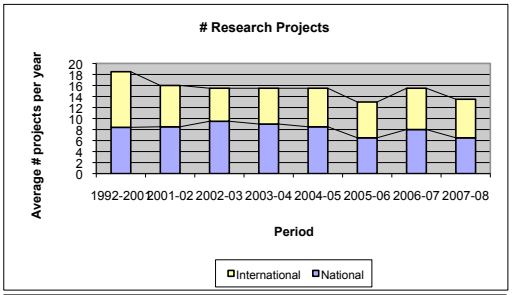
Marcelo Coniglio , Campinas, Brazil. 2008-06-18 - 2008-06-18.
Participate as discussant in the PhD exam of João Alcântara.

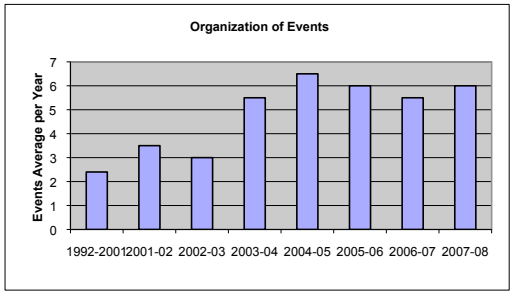
Richard Scheines , Carnegie Mellon, USA. 2008-06-17 - 2008-06-22.
Collaborate in research and give talks on Causal Discovery and Computation and on Teaching with the Computer.

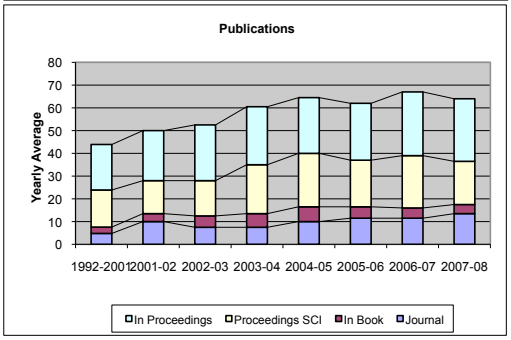
Julian Padget , University of Bath, United Kingdom. 2008-10-14 - 2008-10-15.
To participate in the MSc Jury of Luca Quaglia and Belopeta Mito.

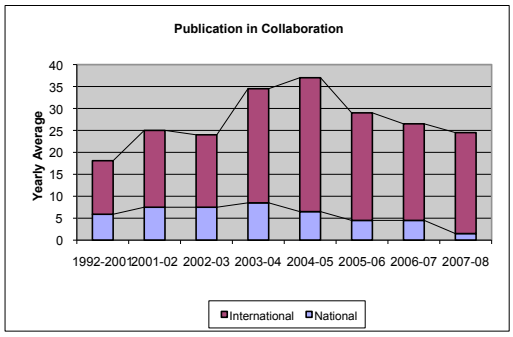
Boris Mirkin , Birkbeck, University of London, U.K.. 2008-02-25 - 2008-03-01.
work in the framework of the COPSRO project.

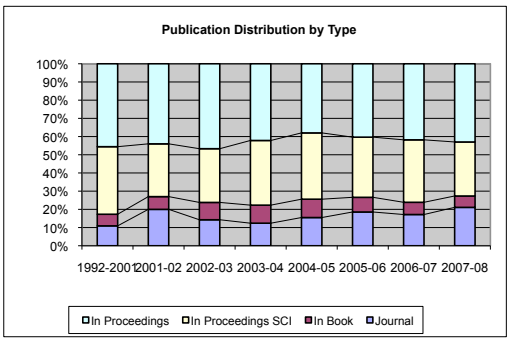
7 CENTRIA evolution graphics in 2008

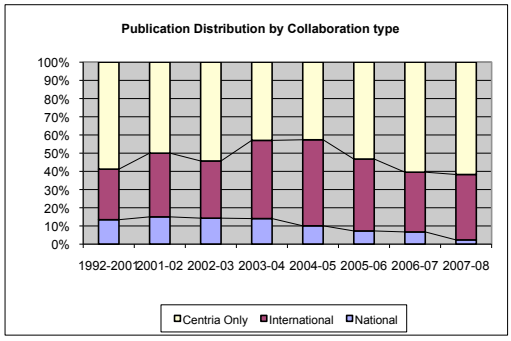


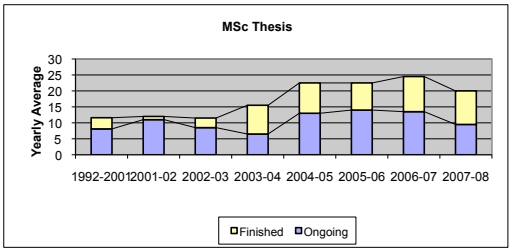


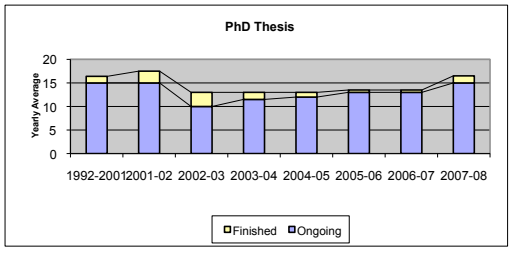


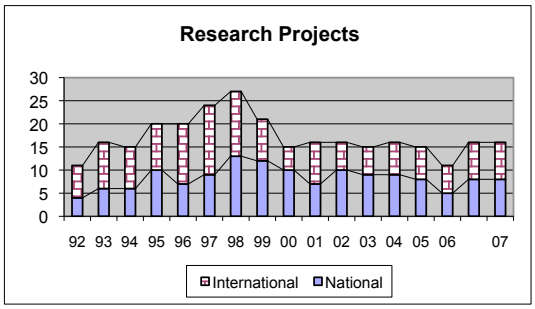








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International
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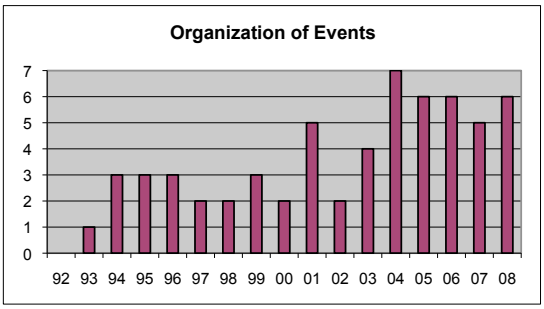
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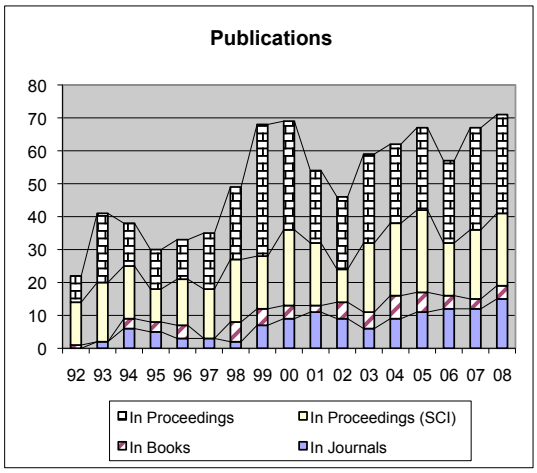
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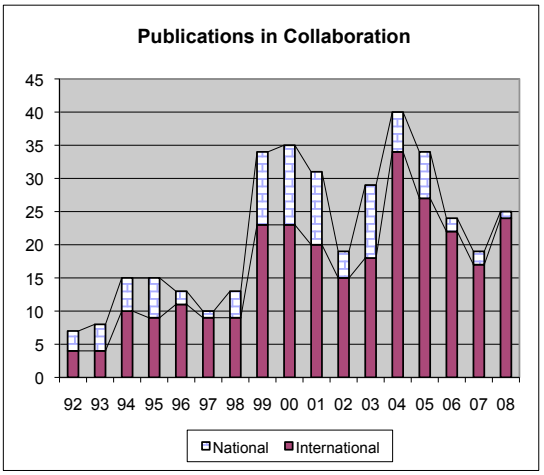
In Proceedings
In Proceedings (SCI)
In Books
In Journals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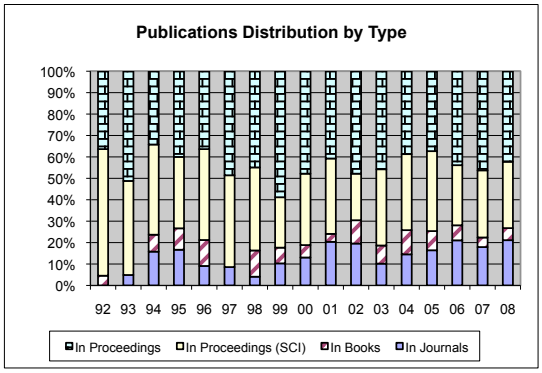
Publications Distribution by Type
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
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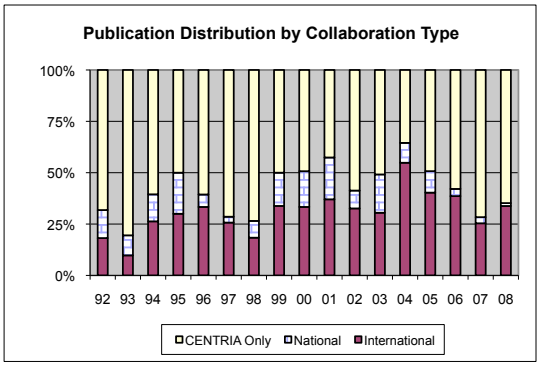
In Proceedings
In Proceedings (SCI)
In Books
In Journals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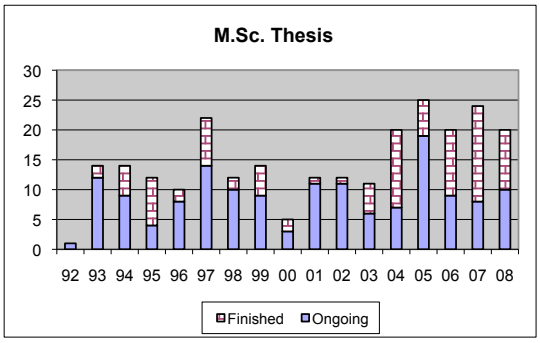
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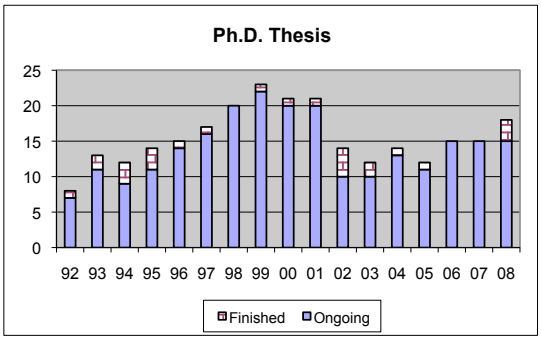
Finished
Ongoing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