

**PRESENTATION OF THE  
LOGICS AND ARTIFICIAL INTELLIGENCE  
RESEARCH GROUP**

**C.E.A.B. - C.S.I.C.**

January 1987

Grup d'Intel·ligència Artificial i Lògica  
Centre d'Estudis Avançats CSIC  
Camí de Santa Bàrbara, 17300 Blanes, Girona, Spain  
(72) 33 61 01

LOGICS AND ARTIFICIAL INTELLIGENCE RESEARCH GROUP

## (G R I A L)

INTRODUCTION

The Centre d'Estudis Avançats de Blanes (CEAB) belongs to the Consejo Superior de Investigaciones Científicas (CSIC), the larger state owned research organization in Spain.

In the CEAB there are three main research lines :

- 1) Artificial Intelligence
- 2) Marine Ecology
- 3) Oceanography.

The Logics and Artificial Intelligence Research Group (GRIAL) is formed by 11 researchers and several visiting scientists. The GRIAL focuses its research in the following areas of AI :

- \* Approximate Reasoning
- \* Learning and Knowledge Acquisition
- \* Logic Programming

GRIAL addresses both, the fundamental and applied aspects of the above areas. The fundamental research concerns the study of multiple valued and fuzzy logics and is carried out in close collaboration with the Department of Mathematics and Statistics of the Universitat Politècnica de Catalunya, three professors of this department are research associates of GRIAL. The applied research concerns the development of expert systems building tools with approximate reasoning and knowledge acquisition capabilities, and the actual building of expert systems in different domains within the framework of contracts with the industry and other institutions.

CURRENT RESEARCH PROJECTS**ACRE** (Knowledge Acquisition and Approximate Reasoning)

This project is supported by the following institutions :

- \* CAICYT (Advisory Commission for Scientific and Technical Research).
- \* CSIC
- \* CEE
- \* DEC external research agreement
- \* FISSS (Funds of the Social Security for Health Research)

ACRE consists of the following subprojects :

*LAMDA (Learning Algorithms for Multivariate Data Analysis)*

In this part of the project we study a basic mechanism of learning : the classification process from the point of view of conceptual clustering (grouping elements conceptually similar) for this we use techniques based on fuzzy logics that lead to fuzzy partitions of the set of elements. The fuzzy logic approach is also used to linguistically characterize the classification results by means of high level descriptions.

*EAR (Knowledge Acquisition and Structuring System)*

In this part of the project we are developing a methodology partly based on Personal Construct Theory whose goal is to build an implementation independent knowledge level description of a knowledge base. The system implements interview protocols for eliciting the expert's knowledge through a dialogue guided by the analysis of the already acquired knowledge. The conceptual mechanism involved is the EAR (Elicit-Analyze-Refine) cycle focusing the expert on his disagreements concerning the results of the analysis and engaging him in the apposite disagreement resolution procedures of knowledge refinement. The interview protocols also support acquisition and aggregation of knowledge from multiple experts through a structured process of negotiation for consensus.

*MILORD (Inference Engines with Approximate Reasoning)*

In this part of the project we are developing inference engines with approximate reasoning capabilities based on fuzzy logics. The system allows to perform different calculi of uncertainty on an expert defined set of linguistic terms expressing uncertainty. Each calculus corresponds to specific conjunction, disjunction and implication operators. The system can perform these computations off-line and store the results in matrices. When MILORD is run, the propagation and combination of uncertainty is performed by simply accessing the precomputed matrices. The system also deals with default reasoning in the same framework of uncertainty management. MILORD is now being applied to build an expert system for diagnosis and treatment of pneumoniæ in collaboration with the hospital La Alianza Mataronina.

**ESTELA (Relational and Equational Logic Programming Environment)**

This project is supported by the following institutions :

- \* CAICYT
- \* ITT-Standard Eléctrica

The purpose of this project is to build a logic programming environment including not only relational logic but also equational logic in a way transparent to the user, i.e. the user has to be allowed to combine both types of logic programming.

STAFF

**Ramon López de Mántaras.** Head of the GRIAL. Research Scientist.  
Ph.D. Computer Science.

**Josep Aguilar-Martín.** Research Scientist. Ph.D. Engineering.  
On leave from the LAAS of the CNRS Toulouse.

**Jaume Agustí.** Research Scientist. Ph.D. Physics.

**Francesc Esteva.** Research Scientist (part-time). Ph.D. Mathematics.

**Llorenç Valverde.** Research Associate (part-time). Ph.D. Comp. Science.

**Ulises Cortés.** Research Associate (part-time). Ph.D. Computer Science.

GRADUATE STUDENTS

**Joan Figuerola.** Research Assistant. M. Sc. Computer Science.

**Lluís Godó.** Research Assistant. M. Sc. in Mathematics and in Engineering.

**Enric Plaza.** Research Assistant. M. Sc. in Computer Science

**Carles Sierra.** Research Assistant. M. Sc. in Computer Science.

**Nuria Piera.** Research Assistant (part-time). M. Sc. in Mathematics.

VISITING SCIENTISTS (1986-1987)

**Dr. Settimo Termini.** Laboratorio di Cibernetica of the CNR (Naples).

**Dr. Mario Furnari.** Laboratorio di Cibernetica of the CNR (Naples, Italy).

**Dr. Jorge Pluss.** Universidad Nacional del Rosario (Argentina)

COMPUTER FACILITIES

Shared facilities :

VAX 11/785 with VMS

Own facilities :

2 DEC AI Vaxstations (one with VMS and one with ULTRIX)

Xerox 1186

several microcomputers and a laser printer.

SELECTION OF RECENT PUBLICATIONS (1985-1986).

*R.López de Mántaras, J.Aguilar* (1985), Self-learning pattern classification using a sequential clustering technique. **Pattern Recognition Journal** vol.18, 3-4, pp. 271-277.

*E.Trillas, L.Valverde*(1985), On modus ponens in fuzzy logics. **IEEE Conf. on Multiple-Valued Logics**, Canada. IEEE Press. pp. 294-301.

*E.Plaza, R. López de Mántaras* (1985), Knowledge acquisition and refinement of a fuzzy conceptual base. **NAFIPS Workshop on Fuzzy Expert Systems and Decision Support**, Atlanta, USA.

*U.Cortés, R.López de Mántaras, C.Sierra* (1985), A multilevel representation scheme. **COGNITIVA-85**, Paris. pp. 561-566.

*E.Trillas, L.Valverde* (1985), On mode and implication in approximate reasoning. In : **Approximate Reasoning in Expert Systems**, Elsevier Sc. Pub. pp. 157-166.

*E.Trillas, L.Valverde* (1985), On implication and indistinguishability in the setting of fuzzy logic. in : **Management Decision Support Systems using Fuzzy Sets and Possibility Theory**, Verlag TUV Rheinhold. pp.198-212.

*J.Agustí, R. López de Mántaras* (1985), Inteligencia Artificial, técnicas y actividades principales, **Mundo Electrónico**, 150, pp.43-50.

*R.López de Mántaras* (1985), Modelos de razonamiento aproximado, **Mundo Científico**, vol.5, 53, pp.1246-1256.

*L.Valverde* (1985), Lógica polivalente y vaguedad lingüística. **I Congreso de Lenguajes Naturales y Lenguajes Formales**, Blanes. pp.128-148.

*L.Godo* (1985), Modus tollens en lógica difusa, **IV Cong. Català de Lògica**, Barcelona. pp. 77-79.

*U.Cortés, R.López de Mántaras, E.Plaza* (1985), Anàlisi lògica d'inferències subjectives. **IV Congrés Català de lògica**, Barcelona. pp. 41-46.

*R.López de Mántaras* (1986), Técnicas de representación del razonamiento aproximado. Chapter 4 of the book : **Inteligencia Artificial : Sistemas Expertos** (J.Cuena, G.Fernández, R.López de Mántaras, F.Verdejo). Alianza Editorial. pp. 69-110.

*R.López de Mántaras, U.Cortés, E.Plaza, C.Sierra* (1986), MILORD : An expert systems building tool with approximate reasoning. in : **Fuzzy Logics in Knowledge Engineering**, Verlag TUV Rheinhold. PP. 182-193.

*R.López de Mántaras, J.Agustí, U.Cortés, E.Plaza.* (1986), Fuzzy knowledge engineering techniques in scientific document classification. **ACM SIGART Int. Symp. on Methodologies for Intelligent Systems**. Knoxville, Tennessee, USA. ACM SIGART Press. pp. 94-102.

*E.Plaza, C.Alsina, R.López de Mántaras, J.Agustí, J.Aguilar* (1986), Consensus and knowledge acquisition. **Int. Conf. on Information Processing and Management of Uncertainty in Knowledge Based Systems**, Paris. pp. 214-217.

*R.López de Mántaras, E.Plaza, J.Agustí* (1986), Knowledge elicitation and analysis for approximate reasoning systems. **II Int. Conf. on Artificial Intelligence**, Marseille, France. pp. 91-108.

*R.López de Mántaras, E.Plaza, J.Agustí, U.Cortés* (1986), A personal construct approach to knowledge elicitation. **ECAI'86 (European Conference on Artificial Intelligence)**, Brighton, UK. pp.128-133.

*J.Padget, J.Chailoux, T.Christaller, R.López de Mántaras, et. al.* (1986), Desiderata for the standardisation of LISP, **ACM Conference on Lisp and Functional Programming**, Cambridge, USA. pp. 54-66.