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Nature Inspired Problem-Solving Methods in Knowledge Engineering

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Preface

The Semantic Gap

There is a set of recurrent problems in AI and neuroscience which have restricted their progress from the foundation times of cybernetics and bionics. These problems have to do with the enormous semantic leap that exists between the ontology of physical signals and that of meanings. Between physiology and cognition. Between natural language and computer hardware. We encounter this gap when we want to formulate computationally the cognitive processes associated with reasoning, planning and the control of action and, in fact, all the phenomenology associated with thought and language.

All "bio-inspired" and "interplay" movement between the natural and artificial, into which our workshop (IWINAC) fits, faces this same problem every two years. We know how to model and reproduce those biological processes that are associated with measurable physical magnitudes and, consequently, we know how to design and build robots that imitate the corresponding behaviors. On the other hand, we have enormous difficulties in understanding, modeling, formalizing and implementing all the phenomenology associated with the cognition field. We do not know the language of thought. We mask our ignorance of conscience with the term emergentism.

This very problem recurs in AI. We know how to process images, but we do not know how to represent the process for interpreting the meaning of behaviors that appear in a sequence of images computationally, for example. We know how to plan a robot's path, but we do not know how to model and build robots with conscience and intentions. When the scientific community can link signals and neuronal mechanisms with "cognitive magnitudes" causally we will have resolved at the same time the serious problems of bio-inspired engineering and AI. In other words, we will know how to synthesize "general intelligence in machines."

To attempt to solve this problem, for some time now we have defended the need to distinguish between own-domain descriptions of each level and those of the external observer domain. We also believe that it is necessary to stress conceptual and formal developments more. We are not sure that we have a reasonable theory of the brain or the appropriate mathematics to formalize cognition. Neither do we know how to escape classical physics to look for more appropriate paradigms.

The difficulty of building bridges over the semantic gap justifies the difficulties encountered up to now. We have been looking for some light at the end of the tunnel for many years and this has been the underlying spirit and intention of the organization of IWINAC 2007. In the various chapters of these two books of proceedings, the works of the invited speakers, Professors Monserrat and Paun, and the 126 works selected by the Scientific Committee, after

the refereeing process, are included. In the first volume, entitled "*Bio-inspired Modeling of Cognitive Tasks*," we include all the contributions that are closer to the theoretical, conceptual and methodological aspects linking AI and knowledge engineering with neurophysiology, clinics and cognition. The second volume entitled "*Nature-Inspired Problem-Solving Methods in Knowledge Engineering*" contains all the contributions connected with biologically inspired methods and techniques for solving AI and knowledge engineering problems in different application domains.

An event of the nature of IWINAC 2007 cannot be organized without the collaboration of a group of institutions and people who we would like to thank now, starting with our university, *UNED*, and its Associate Center in Cartagena. The collaboration of the Universitat Politécnica de Cartagena and the Universitat de Murcia has been crucial, as has the enthusiastic and efficient work of José Manuel Ferrández and the rest of the Local Committee. In addition to our universities, we received financial support from the Spanish Ministerio de Educación y Ciencia, the Fundación SENECA-Agencia Regional de Ciencia y Tecnología de la Comunidad de Murcia, *DISTRON s.l.* and the Excelentísimo Ayuntamiento de Cartagena. Finally, we would also like to thank the authors for their interest in our call and the effort in preparing the papers, condition *sine qua non* for these proceedings, and to all the Scientific and Organizing Committees, in particular, the members of these committees who have acted as effective and efficient referees and as promoters and managers of pre-organized sessions on autonomous and relevant topics under the IWINAC global scope.

My debt of gratitude with José Ramón Alvarez and Félix de la Paz goes, as always, further than the limits of a preface. And the same is true concerning Springer and Alfred Hofmann and their collaborators Anna Kramer and Erika Siebert-Cole, for the continuous receptivity and collaboration in all our editorial joint ventures on the interplay between neuroscience and computation.

June 2007 José Mira

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