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**SUBPROGRAMA RAMON Y CAJAL  
CONVOCATORIA 2011**

**Nombre:** ONTAÑÓN VILLAR, SANTIAGO JUAN

**Referencia:** RYC-2011-08373

**Area:** Ciencias de la Computación y Tecnología Informática

**Correo electrónico:** santi.ontanon@gmail.com

**Título:**

Argumentation and Learning in Multiagent Systems

**Resumen de la Memoria:**

The main research of the applicant is Argumentation and Learning in Multiagent Systems (ALMAS). Traditional machine learning techniques deal with the problem of learning from a centralized source of data. However, in many real-world applications data is distributed, or just too large to be considered in a centralized way. This can be modeled using multiagent systems (MAS), where individual agents have only access to a subset of the data. Individual agents may apply machine learning on their own, but it would be desirable if these agents could collaborate with other agents, and thus make use of all the distributed data, instead of only that directly available to it. The goal of this research line is to design, analyze and implement models of multiagent learning that allow groups of agents to individually learn from separate repositories of data and then improve their learned knowledge through collaboration with other agents in the system. The focus will be to model collaboration as argumentation processes, where agents communicate and argue about their individual inductive inferences. The intuitive idea is to follow the scientific discovery process in human scientific communities, where each individual researcher performs experiments locally based on information available to her, and formulates hypotheses. Then, groups of researchers argue to form agreed-upon theories that explain the knowledge collectively known to all of them. I will study the interplay between machine learning, argumentation and other fundamental aspects of multiagent systems such as learning from communication, and the communication of inductive inferences. The ALMAS framework aims at enabling the application of collaborative machine learning techniques to open multiagent systems.

**Resumen del Curriculum Vitae:**

Santiago Ontañón Villar is a "Juan de la Cierva" researcher at the Artificial Intelligence Research Institute (IIIA - CSIC) in Barcelona. His main research line is the study of the integration of machine learning and case-based reasoning techniques into multiagent systems. He is also interested in relational machine learning, and on the application of artificial intelligence to complex domains such as computer games. He got his PhD in computer science in 2005 from the Autonomous University of Barcelona (UAB) under the supervision of Dr. Enric Plaza i Cervera in the topics of case-based reasoning and machine learning in multiagent systems. He was awarded with an "Outstanding PhD Award" given only to 11 out of 50 PhD theses defended during the period 2005-2008. Additionally, his dissertation made him a finalist for the European Cor Bayen Award (given to the most promising young researchers in computer science and applied mathematics). He then joined the Applied Mathematics and Analysis (Maia) department of the University of Barcelona (UB) for two academic years. After that, he was hired at the Georgia Institute of Technology (Georgia Tech), in Atlanta (USA), with a three year postdoctoral contract in the Integrated Learning DARPA project. During his period at Georgia Tech, he co-advised (with Professor Ashwin Ram) 9 MS students and a PhD student. Currently he is co-advising one PhD student (with Enric Plaza i Cervera) and advising several MS students. Santiago has participated in 5 different research projects: two DARPA projects while being in Georgia Tech, and three national projects after his return to IIIA as a Juan de la Cierva researcher. Currently he is the principal investigator of a research contract in the BUSCAMEDIA CENIT project with a budget of €135K in the topic of automatic narrative generation using case-based reasoning. Santiago has published 72 scientific publications: 5 journal articles (2 of them in the Computational Intelligence Journal, ranked number 1 among the AI journals by impact factor), 6 book chapters, 48 conference papers and 13 workshop papers. Additionally, his dissertation has been published as a book by VDM Verlag.



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**SUBPROGRAMA RAMON Y CAJAL  
CONVOCATORIA 2011**

**Nombre:** NAVARRO ARRIBAS, GUILLERMO

**Referencia:** RYC-2011-09631

**Area:** Ciencias de la Computación y Tecnología Informática

**Correo electrónico:** guillermo.navarro@gmail.com

**Título:**

Adaptable authorization and semantic privacy

**Resumen de la Memoria:**

The research proposed in this application is divided in two main lines. First on adaptable authorization and access control models and technologies, where we propose the development and introduction of inter-domain attribute conversions to support inter-operation of heterogeneous security systems, and context aware access control. The use of a fuzzy approach to authorization will be considered with interesting approaches enabling flexibility, adaptability, and usability. The second line is centered on semantic privacy or anonymization, more precisely, in advancing the field of privacy information retrieval, and proposing a very novel line on the anonymization of unstructured documents, including the declassification of confidential documents or the secure (from a privacy point of view) dissemination of corporate, or judicial notes/summons. These lines are supported by the expertise acquired by the candidate during his doctoral and postdoctoral stages. The outcome of these research lines will be disseminated in scientific venues (international journals and conferences). Furthermore, an important effort has been placed in focusing some research lines towards technology transfers. Some of the proposed lines have already raised interest from the industry (both national and European) and are very likely to provide interesting solutions if properly conducted. In this project we have also planned the supervision of at least two PhD. students, application for national and European projects, with the aim of leading projects related to the semantic privacy research line, and to continue establishing good international and national collaborations with leading researchers in the fields of study.

**Resumen del Curriculum Vitae:**

The candidate finished his PhD on authorization in distributed systems in the Universitat Autònoma de Barcelona. He has worked in the UAB as a doctoral scholarship holder and "profesor ayudante" from 2001 to 2008, after that we made a postdoctoral stage in the Artificial Intelligence Research Institute from the Consejo Superior de Investigaciones Científicas. He is currently a lecturer (profesor ayudante doctor) in the Universitat Autònoma de Barcelona. During his research career, he has participated in 17 research projects (autonomic, national, and international), has published 10 papers in ISI-JCR indexed journals 14 papers in LNCS/LNAI series (some of them also indexed in the ISI-JCR), and 43 papers in proceedings and book chapters from important international and national conferences. He has done several research stays in internationally recognized centers: Swedish Institute of Computer Science (2003), and University College Cork (2004, and 2009), and collaborates with relevant research both at national and international level. He has been involved in workshop and conferences as PC chair, PC member, and organizer, has co-edited two post-proceedings volumes and is currently co-editing and special issue in an ISI-JCR indexed journal.



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**SUBPROGRAMA RAMON Y CAJAL  
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**Nombre:** SCIAVICCO , GUIDO

**Referencia:** RYC-2011-07821

**Area:** Ciencias de la Computación y Tecnología Informática

**Correo electrónico:** guido@um.es

**Título:**

Temporal and Spatial Reasoning: New Methods and Practical Applications

**Resumen de la Memoria:**

Spatial and temporal reasoning are two, strongly interconnected, important research fields in Artificial Intelligence, and present a number of open questions, both theoretical and practical. Temporal interval logics is one of the most applicable areas, and, at the same time, one of the areas which received less attention. The reason of this disparity is their well-known bad computational behaviour, where undecidability is the rule and decidability is the exception. While in recent years we have almost completed a classification of all possible unary interval logics, there is a number of still open problems. These are mainly connected with 1) decidability / undecidability on specific classes of linearly ordered sets, 2) representation theorems, 3) implementable and efficient automatic reasoning methods, and 4) integration of mixed methods that include both points and intervals, not to mention the possibility of metric extensions of such logics (this line has been already started with a research project between Spain and South Africa financed by the Spanish Ministry of Education and Science). Other questions that remain unsolved at the moment are: Is it possible to identify a fragment of Propositional Neighbourhood Logic (a recently presented temporal logic for interval with interesting characteristics of expressive power and very good computational behaviour) for which a resolution method is applicable? For which fragments, beside PNL, there exists a sound and complete axiomatic system? Both new and known results can be applied to the phase of study of models, techniques, and tools for the control of the assistance quality during intra and extra-hospital patients follow-up, through the IDEATIO project, in which the Artificial Intelligence and Knowledge Engineering (AIKE) research group, of which the applicant is a member, is included. On the other hand, positive results can be generalized and extended to the spatial case. The logic SpPNL, which is the spatial bidimensional version of PNL, presents a computational behavior worse than that of PNL, but still better than almost any other spatial logics presented in the literature. Recently, a decidable fragment of SpPNL, called WSpPNL, has been found: this is the first decidable spatial logic for extended regions with directional relations. This line deserves more research, since we do not know yet how far can we extend it, both qualitatively and quantitatively. Results in the area of spatial reasoning can be directly applied in the context of spatial databases, another very important area of Computer Science.

**Resumen del Curriculum Vitae:**

Guido Sciavicco posee una licenciatura (5 años) en Informática por la Universidad de Udine (Italia), y un doctorado en Informática por la misma Universidad, homologado en 2008 por la Universidad de Murcia. Se ha interesado principalmente de lógicas temporales y espaciales, con especial atención a problemas de decidibilidad, indecidibilidad, sistemas axiomáticos, sistemas de deducción automáticas, y poder expresivo de los lenguajes lógicos. Guido Sciavicco es (co)autor de aproximativamente 50 artículos entre revistas internacionales JCR, congresos nacionales e internacionales (incluyendo 2 participaciones en la main track de ECAI/IJCAI). Sus artículos han sido citados un total de aproximativamente 400 veces, y posee un índice H de 10. Ha trabajado en la Universidad de Udine, de Murcia, y actualmente es profesor visitante en la Universidad para la Tecnología y la Ciencia de la Información en Ohrid (Macedonia). Guido Sciavicco posee una variada experiencia en la docencia de cursos bases y avanzados en Informática, habiendo estado enseñando durante más de 8 años en tres idiomas: Inglés, Español e Italiano.



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**SUBPROGRAMA RAMON Y CAJAL  
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**Nombre:** BILBAO CASTRO, JOSE ROMAN

**Referencia:** RYC-2011-08089

**Area:** Ciencias de la Computación y Tecnología Informática

**Correo electrónico:** jrbcast@gmail.com

**Título:**

High Performance Heterogeneous Computing for Structural Biology and X-Ray Tomography

**Resumen de la Memoria:**

Image processing techniques in Structural Biology has shown to be a powerful tool to elucidate the three-dimensional structure of biological specimens at different scales. One of the Imaging techniques, known as electron microscopy has shown the potential to reach quasi-atomic resolution in structurally homogeneous and heterogeneous studies in single particles studies (for small specimens like proteins). Nevertheless, due to technical and biological limitations, the obtained image projections are very noisy. Thus, to reach high resolutions in the final reconstruction, large quantities on projections are needed, as well as powerful and complex image processing algorithms. Both issues negatively affect computational performance and require new computing strategies to achieve reasonable processing times. Apart from single particle studies, electron tomography and recently X-Ray tomography have emerged as new tools to study structural conformation of big specimens like cell organelles and whole cells. The work proposed here is in the line of previous research work performed during the last nine years. It will be devoted to the development of new image processing algorithms applied to the fields of Electron and X-Ray tomography that, opposite to the single particle techniques, allow the study of thicker specimens like complete cells. Different aspects of the chained process, from the generation of the images in the microscope to the final 3D reconstruction, will be tackled. In particular, X-Ray tomography in structural biology is an almost virgin field of research and much work has still to be done. First, images pre-processing, including denoising and normalization processes must be performed. Then, different images must be perfectly aligned which is yet an unresolved problem. The reconstruction algorithms themselves will be an important field of work. Finally, the reconstructed volume must be segmented into its meaningful smaller components (i.e. cell organelles like nucleoli, ribosomes, etc.). Segmentation is currently performed by hand as no efficient methods have been yet devised that perform the job automatically with a reasonable precision. All those developments will require the implementation of high performance computing techniques due to their huge computational costs. Memory requirements will be very big for tomography studies which will require to distribute work load across different machines. Evendistributing workload across machines the computational requirements will still be considerable, precluding prospective users to adopt these new technologies. Thus, parallel computing will be vital to ensure new algorithms success and will be implemented by means of different parallelization techniques, including GPU computing and multi-thread computing. This work will imply collaborations with people coming from different disciplines like computer science, physics, biology and telecommunications. This results in a challenging and encouraging project which, despite being oriented at the Biology field, will be of broad application in other areas of knowledge.

**Resumen del Curriculum Vitae:**

Started my studies in computing science back in 1996. I obtained my PhD in computer science in 2006 at the University of Almería, having been a pre-doctoral fellowship holder at the Spanish National Center for Biotechnology. During that time I was a visitor for 4,5 months at the Edinburgh Parallel Computing Centre. In 2006 I signed a postdoc contract under the 'Juan de la Cierva Programme' that finished in 2009. Since then, I have been under different postdoc contracts until 2011 that I gained I postdoc, four years contract with the Cajamurcia Social Fund. Apart from computer science I have also followed agricultural sciences studies and a master in research for university teachers. I have, therefore, an interdisciplinary background. My main areas of interest are those related to High Performance Computing. This includes developments in Message-Passing computing, Multithreaded computing, Grid computing and GPU computing. I have also a strong background on digital 2D and 3D image processing. I have mainly applied these studies to the Structural Biology Field, where really big image processing problems must be solved in a reasonable time. I have participated in 9 different research projects and in two research contracts. I have co-authored 18 publications, including 3 book chapters. 9 of them as first author and 14 of the journals are indexed in the JCR, with an average impact factor of 3.05. I have also participated in 15 congresses. I would like also to stress my multidisciplinary background, not only having a PhD in Computer Science but also having near-to-completion studies in Agricultural Sciences (two subjects left). This allows me to have a wider knowledge of other fields and existing scientific problems. I am currently working on both fields and I have found this to be synergistic with many of the knowledge of one field being of potential application into the other.



**Nombre:** DE GISPERT RAMIS, ADRIA

**Referencia:** RYC-2011-08378

**Area:** Ciencias de la Computación y Tecnología Informática

**Correo electrónico:** agispert@gmail.com

**Título:**

Statistical Machine Translation

**Resumen de la Memoria:**

The ultimate goal of Machine Translation (MT) is to develop engines that are capable of automatically translating text or audio material from one language to another efficiently and with high quality. This is a long-term human aspiration that although it is yet far from realisation, has become more plausible in the last 15 years as data-driven statistical approaches have been introduced to complement the classical ones based on linguistic knowledge. In Statistical Machine Translation (SMT), the translation engine is expected to learn how to perform this difficult task from large collections of examples in the form of bilingual texts. SMT is a core challenge in Natural Language Processing (NLP) which draws from a wide variety of fields such as statistical methods, pattern recognition, machine learning, computational linguistics, automata theory and speech processing. Its main goals are to formulate statistical models that describe the process of translating any text from one language to another and to develop estimation procedures for these models in order to automatically learn from real-life examples. It also concerns the implementation of efficient decoding engines capable of providing useful, good-quality translations of text and speech for multiple language pairs. These need to explore a gigantic space of probable translation candidates and find the most likely one according to the statistical models. The field of SMT is relatively recent, very popular and highly interdisciplinary, including engineers, computer scientists, mathematicians and linguists, who approach it from different and complementary angles. With hundreds of papers being published each year, it is suffering dramatic changes as MT applications are instantly providing translation services with increasing, but yet insufficient, quality to the vast and dynamic world wide web. It is a meeting point of many unsolved Natural Language Processing tasks, such as morphological and syntactic analysis, word sense disambiguation, semantic role labelling, and named entity recognition, among others. At the same time, it opens up the possibility of novel powerful applications emerging from MT such as speech-to-speech translation, or multilingual information retrieval. In short, Statistical Machine Translation is a compact name for an assortment of difficult language-related problems, brought together to perform a tremendously hard task. This is the main area of my research. The research lines I am currently working in are:- integration of natural language generation systems to ensure fluency in automatic translation output,- efficient exploitation of massive distributed language models for the translation task- online-based user interaction with SMT systems and model adaptation towards user feedback- data-driven induction of synchronous context-free grammars- automatic extraction of morpho-syntactic features for hierarchical phrase-based translation- exhaustive and efficient search with the use of Finite-State Automata- MT system combination by means of Minimum Bayes Risk decoding- word alignment models that incorporate linguistic context.

**Resumen del Curriculum Vitae:**

I am a Telecommunications Engineer (2001) by the Universitat Politècnica de Catalunya (UPC), and Ph.D in Signal Theory and Communications (2007) by the same university. My scientific career started in 2002 when Statistical Machine Translation (SMT) was emerging as a new research field mainly derived from speech recognition. Under the supervision of Prof. José B. Mariño, I did my PhD at the department of Signal Theory and Communications of the UPC, which belongs to the TALP Research Centre on Speech and Language Technologies, together with the Software & LSI department. I was funded by the &FI& predoctoral scholarship program of the Catalan Government (2003-2006). As a PhD student, I contributed directly to the creation of a research group in SMT at the department of Signal Theory and Communications of the UPC, where there was extensive experience in speech recognition but no infrastructure in machine translation. I implemented the first statistical system for text and speech translation. I had a leading role in the development of a novel translation model based on bilingual N-grams, and in the deployment of a powerful decoder for it. Today, the system I contributed to develop is still central to the research on SMT being carried out in this department of the UPC. This line of work led to many conference articles, and various journal articles (Natural Language Engineering, Speech Communication, and Computational Linguistics). In January 2007 I moved to the Machine Intelligence Laboratory of the University of Cambridge as a post-doctoral research associate. My initial goal was to improve an existing phrase-based translation system implemented with Weighted Finite-State Transducers (WFSTs), and to take charge of its participation in international evaluations of translation quality, as a requirement of the US DARPA-funded AGILE project that supported my position. This research group comprised one academic and two PhD students, and had only published 5 articles in SMT. Since my arrival, more than 20 translation papers of high quality have been published. A major reason for this has been the development of a new translation system based on hierarchical phrases and implemented with WFSTs. This system, which I developed with the help of a PhD student from the Universidad de Vigo (Spain) who visited our group in 2008 and whom I directly supervised, is able to reuse well-known highly-optimized finite-state structures and search algorithms for the translation task. This eliminates the need for a dedicated decoder and allows research to concentrate on the statistical modeling aspects rather than on time-consuming coding which is quickly outdated if the translation model changes. This system was ranked at the top of the open Machine Translation evaluation organized by the National Institute of Standards and Technology (NIST, USA) in 2009, in the Arabic-to-English track. This work has been published at the high-impact Computational Linguistics journal. In September 2009, my research was deemed very valuable by the Department of Engineering of the University of Cambridge, and I was offered the post of University Lecturer, despite being the only candidate among the 4 finalists who had not obtained a PhD from this highly prestigious university. Therefore, since then I have complemented my research with teaching responsibilities.



**Nombre:** ALESSANDRO , ARTUSI

**Referencia:** RYC-2011-09372

**Area:** Ciencias de la Computación y Tecnología Informática

**Correo electrónico:** artusialessandro4@googlemail.com

**Título:**

High Level of Realism Reproduction in Real-Time Environment

**Resumen de la Memoria:**

My research is concerned with the development of techniques to improve the level of realism of a simulated scene and being able to apply these techniques in a real-time environment such as games and interactive environment for different applications in medicine and industry. This can be achieved either simulating correctly the physical and psychophysical phenomena or faking the reality. This line of research involves the integration and synergy of different areas in different steps: Capturing, Manipulation and Visualisation. Capturing, involves the acquisition of real world data such as real-light information (High Dynamic Range (HDR) content), Bidirectional-Reflection/Texture functions, Color Information. Also novel acquisition hardware may be developed that improves the state-of-the-art of the current available hardware used for capturing these data. Manipulation is required to compress these data to be treatable in real-time context. Also Image Processing techniques are used to preserve details and edge information to remove noise or possible artefact of the original input data. Color is also an important aspect for the realism reproduction and this requires to employ techniques to simulate complex aspects of the human visual system and color science techniques to simulate the original color perception. Also global illumination techniques need to be employed to reproduce correctly the physical phenomena of the light interacting with the material properties of an object. Visualisation, employ techniques to integrate this information to be rendered in 2D/3D real-time environment. So 3D technology can be integrated with HDR content to drastically increase the reproduced realism. This involves also the development of novel display technology to directly visualise HDR content, which will drastically improve the state-of-the-art of the current HDR display technology. Finally Energy aware techniques may be employed to reduce the energy consumption and the computation costs required to render these complex data using complex rendering techniques also on mobile technology opening several novel applications and research lines.

**Resumen del Curriculum Vitae:**

After my Master degree in 1998 I won a research fellowship funded by the Italian Ministry MURST and I have been employed at the CNR being responsible of the developed several techniques in the area of color correction and colorimetric characterisation, color appearance and gamut mapping. I have collaborated with Olivetti in the development of color correction sw where several techniques developed by myself have been integrated. As PhD at the Vienna University of Technology I have been working in two EU projects, one local funded project and two International collaborations. My contributions to these projects has been in the development of acceleration techniques in the context of High Dynamic Range compression, generating know-how in the High dynamic range area that afterwards has been used by the Computer Graphics group where I was employed. I have also participated in the administrative tasks in the management of EU projects and I was also a work package coordinator of a 3 million euro EU project (RealReflect project). This project has been evaluated by the EU as one of the most successful IST projects. I have also spent some time in three centres at the University of Bath UK, Max Planck Institute and University of Girona for research collaboration. I have also contributed on the teaching duties and supervised several students in projects and Master thesis. As Assistant Professor at the Computer Science Department of the University of Nicosia. I have received funding for my research through local funding (TONEMAP RPF IPE PLHRO-1104-21) where I have continued to work on my research areas. I have followed students for their Bachelor thesis, teaching several courses at undergraduate level. I have also participated in the development of the Master program in Computer Science. As ERCIM Research fellow I have been 7 months to MSZTAKI in Budapest. I have been working on noise removal technique and I got personal funding for research collaboration with the CORGHI Italia Spa. At the Digital Lab at the University of Warwick I have contributed scientifically to several projects funded locally, supervised Master and PhD students, co-founded a spin-off company (Go-HDR Ltd), to industrial collaborations and the development of the Master program of Computer Graphics. The scientific contribution consisted in the development of novel techniques published feasibility studies, patents and industrial collaborations. During this period I have been also invited as Visiting Professor at the Sarajevo Technical University. My work has been also exhibited at the Exhibition through one of our Industrial collaboration at SIGGRAPH and at the Emerging Technology at SIGGRAPH ASIA. Currently I am employed at CaSToRC Cyprus Institute and I am contribution at the scientific and teaching level (PhD program) and developing a CG Laboratory. Currently I am member of the management committee in a new EU COST action. During all this period I have been invited to several Talks, Lectures and Seminar, Tutorials and Summer Schools, I have offered my services as external examiner and reviewer of Master and PhD students for other Universities, as member of International Programme Committee, as reviewer for Journals and Conferences, as Programme and session chair, organiser of Conferences. I have been Member of the of the Extranet Forum for the European Defence Agency (EDA). My work has been published in Books, Edited proceeding, Journals, Conference and Patents.