

SW@Spain

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Semantic Web and ontology engineering, including ontology languages and tools, and the ontology translation. He has published the books "Ontological Engineering" and "A layered declarative approach to ontology translation with knowledge preservation", and over 30 journal and conference/workshop papers in these areas



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Interoperability between different kinds of ontology development tools, Methodologies and tools for building and merging ontologies, Ontological Reengineering, Ontology Evaluation and Ontology Evolution, as well as Uses of ontologies in applications related with Semantic Web, e-commerce and Knowledge Management.



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versidad San Pablo CEU, and he belongs to the Ontological Engineering Group at Universidad Politécnica de Madrid. His current research activities include, among others: methodologies for ontology development, ontological foundations and ontology mappings.



MSc. José Angel Ramos Gargantilla, Spain, is a PhD student in the Ontological Engineering Group (OEG) at UPM. His research interest is

in Ontology Merging and Mapping. He participates in the projects OntoWeb, Knowledge Web, and Infraestructura tecnológica de servicios semánticos para la web semántica, and has participated in the organization of different events: EKAW02, SSSW03, SSSW04, and SSSW05.

■ *Executive Summary:* This report provides information about the current state of the art in Semantic Web research in Spain. The contents of this report are mainly based on the information that was gathered during the workshop "Ontologías y Web Semántica 2005", which was held in Santiago de Compostela in Novem-

ber 2005, and the contributions that members from most of the research groups working in Semantic-Web-related areas in Spain have provided. The field of Semantic Web is quite widespread in Spain, with important groups developing methods, techniques and tools to support different areas: Ontological Engineering, semantic extraction and annotation from heterogeneous sources, semantic search engines, personalisation and Semantic Web Services.

Furthermore, there is an important community of users of the previous methods, techniques and tools, who act as Semantic Web application developers in the areas of e-commerce, e-Government, e-Science, e-learning, e-finances, e-Health, Software Engineering, Culture and technical regulations.

Besides academic research groups there are also research groups working in non-profit organisations and in industrial companies, what covers the whole range of stakeholders in the area.

As a proof of this active work, many publications in the area have seen the light during 2005. In this report we provide a list of them, classified into groups, so that interested readers can have references to the most important papers or books from these groups.

Local events in Spain cover the spectrum of workshops dedicated to specific areas of technology, as well as round tables and seminars organised by research groups and companies.

Technology uptake by industry in Spain is also a topic covered in this report. Several companies are currently creating technology in this area or providing their expertise as a service to their customers.

Finally, this report describes the current situation of education of Semantic Web related topics in Spain, both at the undergraduate and post-graduate levels. As a highlight of the importance of Semantic Web in edu-

cation in Spain, the first four editions of the Summer School on Ontological Engineering and Semantic Web have been organised in this country.

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1. SW Research in Spain

Research groups working in the Semantic Web in Spain can be classified as follows:

1. Developers of methods, techniques and tools. In this category we can include groups that work in the following areas:

a. **Ontological Engineering**, including groups that work on methods, techniques and tools that give support to different activities of the ontology development lifecycle.

b. **Semantic extraction and annotation from heterogeneous sources**, such as structured sources (e.g., databases), semi-structured sources (e.g., Web pages dynamically generated, with tables), and unstructured sources (e.g., natural language texts).

c. **Semantic search engines**, including methods, techniques and tools to search Intranets and Extranets, using previously annotated sources or making ontology-based query expansion.

d. **Personalisation**, with methods, techniques and tools to personalise user interfaces, searches, application behaviours, etc., based on user models developed with Semantic Web technologies.

e. **Semantic Web Services**, with methods, techniques and tools to develop and execute Semantic Web Services, dealing with problems of discovery, mediation and invocation.

2. Users of the previous methods, techniques and tools, who build semantic applications in the areas of e-commerce, e-Government, e-Science, e-learning, e-finances, e-Health, Software Engineering, Culture and technical regulations.

2. Contributions of Spanish Semantic Web Researchers

Writing a section about the contributions of Spanish Semantic Web researchers to the state of the art in Semantic Web would have been difficult without the help of those researchers, and important omissions would have been made if we had attempted to create such a list by ourselves. Consequently we decided to request from every research group in Spain (including Spanish researchers working abroad) a small list of the publications from their groups that they considered more relevant for this report.

We have classified this list of publications using the same structure than the previous section, with the main organisational blocks of Semantic Web technology developers and Semantic Web technology users.

2.1 Semantic Web technology developers

With respect to developers, we have grouped contributions in the following 5 areas:

Ontological Engineering. Among the most important contributions in this field we can cite a book and several papers in some of the most relevant conferences in the area.

The following publications have to do with the state of the art in Ontological Engineering:

- Gómez-Pérez A, Fernández-López M, Corcho O. Ontological Engineering: with examples from the areas of knowledge management, e-commerce and the Semantic Web. Springer-Verlag. November 2003.

- Sánchez, DM., Cavero, JM., Marcos, E. "The Road Toward Ontologies". In "Ontologies in the Context of Information Systems". Eds. Rajiv Kishore, Ram Ramesh and Raj Sharman. Kluwer.

The following papers deal with some other aspects of Ontological Engineering, such as the selection of ontologies for the Semantic Web, given a set of characteristics (aka requirements) from them, the development of cooperative modelling systems and the development of ontology translation systems:

- Lozano-Tello A. y Gómez-Pérez A. "ONTOMETRIC: A Method to Choose the Appropriate Ontology". Journal Of Database Management. 15(2). pp 1-18, April-June 2004. 2004.

- Beydoun, G., Hoffmann, A., Fernández-Breis, J.T., Martínez-Béjar, R., Valencia-García, R., Aurum, A. (2005) Cooperative Modelling Evaluated. International Journal of Cooperative Information Systems, 14(1):45-71.



Fig. 1. The distribution of major institutions focusing on the Semantic Web research in Spain.

- Corcho O. A layered declarative approach to ontology translation with knowledge preservation. *Frontiers in Artificial Intelligence and its Applications. Dissertations in Artificial Intelligence*. IOS Press. January 2005

Semantic extraction and annotation from heterogeneous sources.

Several groups are working in extraction and annotation from heterogeneous sources, including ontology learning. The following publications can be cited:

- Danger R, Berlanga R, Ruíz-Shulcloper J. "CRISOL: An approach for automatically populating a Semantic Web from Unstructured Text Collections". *Database and Expert Systems, Lecture Notes in Computer Science 3180*, pages 243-253, 2004.

- Navas I, Sanz I, Aldana JF, Berlanga R. "Automatic Generation of Semantic Fields for Resource Discovery in the Semantic Web". *Database and Expert Systems, Lecture Notes in Computer Science 3588*, 706-715, 2005.

- Sánchez D, Isern D, Moreno A. An agent-based knowledge acquisition platform. In: "Multiagent System Technologies". Eds: T.Eymann, F.Klügl, W.Lamersdorf, M.Klusch, M.Huhns. *Lecture Notes in Artificial Intelligence 3550*, pp. 118-129. Springer Verlag, 2005.

- Sánchez D, Moreno A. Web-scale taxonomy learning. Proceedings of the workshop "Learning and extending lexical ontologies by using Machine Learning methods", in the 22nd International Conference on Machine Learning (ICML05). Bonn, Germany, August 2005.

- Verdejo MF, Barros B, Read T, Mizoguchi R(2002)."Applications of a Collaborative Learning Ontology" MICA I 2002 (Mexican International Conference on Artificial Intelligence) LNAI (Lecture Notes on Artificial Intelligence), vol 2313, Springer-Verlag

Semantic search engines. Work in the development and application of semantic search engines, information retrieval engines and ontology-

based query processing can be found in the following publications:

- Vallet D, Fernández M, Castells P. An Ontology-Based Information Retrieval Model. 2nd European Semantic Web Conference (ESWC 2005). Heraklion, Greece, May 2005. Springer Verlag Lecture Notes in Computer Science, Vol. 3532. Gómez-Pérez, A.; Euzenat, J. (Eds.), 2005, ISBN: 3-540-26124-9, pp. 455-470.

- Mena E, Illarramendi A, "Ontology-Based Query Processing for Global Information Systems", Kluwer Academic Publishers, ISBN 0-7923-7375-8, pp. 215, 2001. June 2001.

- Royo JA, Mena E, Bernad J, Illarramendi A, "Searching the Web: From Keywords to Semantic Queries", Third International Conference on Information Technology and Applications (ICITA'05), July 4-7, 2005, Sydney (Australia), IEEE Computer Society, ISBN 0-7695-2316-1, pp. 244-249, July 2005.

- Bagüés M, Bermúdez J, Illarramendi A, Tablado A, Goñi A. "Semantic Interoperation among Data Systems at a Communication Level". *Journal on Data Semantics, Volumen: V 1-24. LNCS 3870*. Springer 2006.

- Palacios J, Cremades J, Costilla C, Towards a Web Digital Archive Ontological Unification, in The Third International Conference on Information Technology and Applications (ICITA'05), Session: Agent, Datamining and Ontologies, ADO'05, Sydney, Australia, IEEE Computer Society, Los Alamitos, California, USA, pp. 221-226, July 2005.

- Lopez V, Pasin M, Motta E. AquaLog: An Ontology-portable Question Answering System for the Semantic Web. ESWC 2005 (European Semantic Web Conference), Crete, Greece.

Personalisation. Two groups work in personalisation for the Web and the Semantic Web, with relevant publications as follows:

- Castells P, Fernández M, Vallet D, Mylonas P, Avrithis Y. Self-Tuning Personalized Information Retrieval in an Ontology-Based Framework. 1st IFIP WG 2.12 & WG 12.4

International Workshop on Web Semantics (SWWS 2005), November 2005. Springer Verlag Lecture Notes in Computer Science, Vol. 3762. Meersman, R.; Tari, Z.; Herrero, P. (Eds.), 2005, ISBN: 3-540-29739-1, pp. 977-986.

- Lozano-Tello A., Macías M., Sánchez F., Sosa E., "Uso de Ontologías en Páginas Web para Mejorar su Accesibilidad a Invidentes", VIII Jornadas de Ingeniería del Software y Base de Datos (JISBD'03), pp 625-634. Ali-cante, SPAIN 2003.

Semantic Web Services. Publications related to Semantic Web Services include the following:

- Fuentes JM, Corella MA, Castells P, Rico M. Semi-automatic Web Service Generation. IADIS WWW/Internet Conference (ICWI 2005). Lisbon, Portugal, October 2005.

- Acuña C., Marcos E., Gómez J.M. and Bussler C. "Towards Web Portal Integration through Semantic Web Services". Int. conference on Next Generation Web Services Practices. Kuala Lumpur - Malasia. IEEE Computer Society, pp. 223-228, 2005

- Gómez-Pérez A, González-Cabero R, Lama M (2004): A Framework for Description, Composition, and Evaluation of Semantic Web Services. IEEE Intelligent Systems. Special Issue on Semantic Web Services.

- Arroyo S, Sicilia MA, López Cobo JM. "Patterns of Message Interchange in Decoupled Hypermedia Systems" *Journal of Networks and Computer Applications*. 2006

The following publications deal with the issue of trust and policy management in the Semantic Web:

- Staab S, Bhargava B, Lilien L, Rosenthal A, Winslett M, Sloman M, Dillon TS, Chang E, Hussain FK, Nejd W, Olmedilla D, Kashyap V. The Pudding of Trust IEEE Intelligent Systems Journal, Vol. 19(5), pp. 74-88, Sep./Oct. 2004

- Gavriloiu R, Nejd W, Olmedilla D, Seamons K, Winslett M, No Registration Needed: How to Use Declarative Policies and Negotiation

to Access Sensitive Resources on the Semantic Web 1st European Semantic Web Symposium, May. 2004, Heraklion, Greece

2.2 Semantic Web technology users

This group contains those groups that use Semantic Web technology to develop other types of technologies or applications in other areas. In e-learning, the following publications have been selected:

- Alonso, A., García, I., Villar, J. R., Benavides, C., Rodríguez, F. J.; "A Framework for Integrating Control Engineering Knowledge in Computer Systems" in Preprints of the 7th IFAC Symposium on Cost Oriented Automation, COA 2004, Ottawa, Canada, June 2004
- Alonso, A., García, I., Villar, J. R., Benavides, C. y Rodríguez, F. J.; "Applying Knowledge Engineering Techniques In Control Engineering Education", in Proceedings of the 6th FAC Symposium on Advances in Control Education ACE 2003, Oulu, Finland
- Amorim R, Lama M, Sánchez E, Riera A, Vila X A Learning Design Ontology based on the IMS Specification, *Journal of Educational Technology & Society*, 9(1):38-57, 2006.
- Mayorga JI, Barros B, Celorrio C, Verdejo MF (2005) "An Ontology-driven portal for a collaborative learning community", 12th International Conference on Artificial Intelligence in Education, *Frontiers in Artificial Intelligence and Applications*, vol. 125, pags. 872-874, IOS Press, ISBN 1-58603-530-4

The following publications refer to the use of ontologies for improving software engineering processes:

- Ruiz, F., Vizcaíno, A. et al. : An Ontology for the Management of Software Maintenance Projects. *International Journal of Software Engineering and Knowledge Engineering*. 14(3), 2004, 323-349.
- García, F., Bertoa, M.F., Calero, C., Vallecillo, A., Ruiz, F., Piattini, M. & Genero, M.: Towards a Consistent Terminology for Software Measurement. *Information and Software*

Technology. In press (<http://www.sciencedirect.com/science/journal/09505849>)

- Calero, C., Ruiz, F., Baroni, A., Brito e Abreu, F. & Piattini, M.: An Ontological Approach to Describe the SQL:2003 Object-Relational Features. *Computer Standards & Interfaces*. In press; available in¹.
- Calero, C., Ruiz, F. & Piattini, M. (eds.): *Ontologies for Software Engineering and Technologies*. Springer (hardcover). To appear in 2006, 350 pages.

The following publications deal with the use of ontologies and Semantic Web technologies for the development and use of case-based reasoning (CBR) systems:

- Díaz Agudo, B. & González Calero, P.A. "An ontological approach to develop Knowledge Intensive CBR systems" 45 páginas. *Ontology-driven Information Systems.*, R. Kishore, R. Ramesh, and R. Sharman, (Eds.), Springer-Verlag
- Recio-García, J.A., Díaz-Agudo, B. & González-Calero, P.A. "A Distributed CBR Framework through Semantic Web Services" *The Twenty-fifth SGAI International Conference on Innovative Techniques and Applications of Artificial Intelligence* pp. 88-101. Max Bramer, Frans Coenen & Tony Allen (Eds.), Springer-Verlag

The following publications deal with the use of ontologies and Semantic Web technologies for the development and use of planning systems:

- de la Asunción M, Castillo L, Fdez.-Olivares J, García-Pérez O, González A, Palao F. SIADEX: an interactive artificial intelligence planner for decision support in forest fire fighting*. *Artificial Intelligence Communications (AIComm)*, vol. 18, n.4, 2005.
- de la Asunción M, Castillo L, Fdez.-Olivares J, García-Pérez O, González A, Palao F. Knowledge and plan execution management in planning fire fighting operations*. *Planning, Scheduling and Constraint satisfaction: from theory to practice*. IOS

Press. Series "Frontiers in Artificial Intelligence and Applications" (117). ISBN 0922-6389.

The following publications describe applications of Semantic Web technologies in the news, financial, e-Government, e-Health, Law and e-commerce domains:

- Castells P, Perdrix F, Pulido E, Rico M, Benjamins R, Contreras J, Lorés J. *Neptuno: Semantic Web Technologies for a Digital Newspaper Archive*. 1st European Semantic Web Symposium (ESWS 2004). Heraklion, Greece, May 2004. Springer Verlag *Lecture Notes in Computer Science*, Vol. 3053. Davies, J.; Fensel, D.; Bussler, C.; Studer, R. (Eds.), 2004, XIII, ISBN: 3-540-21999-4, pp. 445-458.
- Castells P, Foncillas B, Lara R, Rico M, Alonso JL. *Semantic Web Technologies for Economic and Financial Information Management*. 1st European Semantic Web Symposium (ESWS 2004). Heraklion, Greece, May 2004. Springer Verlag *Lecture Notes in Computer Science*, Vol. 3053. Davies, J.; Fensel, D.; Bussler, C.; Studer, R. (Eds.), 2004, XIII, ISBN: 3-540-21999-4, pp. 473-487.
- Costilla C, Palacios J, Cremades J, Vila J. e-government: A Legislative Ontology for the 'SIAP' Parliamentary Management System, in *E-Government: Towards Electronic Democracy*, Proceedings of International Conference TCGOV 2005, *Lecture Notes in Artificial Intelligence*, LNAI 3416-0134, LNCS Series, ISBN 3-540-25016-6, Springer, Berlin, Germany, IFIP 2005, Bozen-Bolzano, Italy, pp. 134-146, March 2005.
- Tablado A, Illarramendi A, Bagüés MI, Bermúdez J, Goñi A. "An Intelligent System for Assisting Elderly People" *Foundations of Intelligent Systems*. ISMIS 2005. 466-474, Mayo-2005 LNAI 3488
- Vidal JC, Lama M, Bugarín A, *Integrated Knowledge-based System for Product Design in Furniture Estimate*, En: *Integrated Intelligent Systems for Engineering Design*, IOS Press, 2006.
- Casanovas P, Poblet M, Casellas N, Contreras J, Benjamins VR, Blázquez

¹ <http://www.sciencedirect.com/science/journal/09205489>

- Casanovas P, Poblet M, Casellas N, Contreras J, Benjamins VR, Blázquez M. Supporting newly-appointed judges: A legal knowledge management case study. *Journal of Knowledge Management* 9(5):7-27, 2005

- Benjamins VR, Casanovas P, Breuker J, Gangemi A. Law and the Semantic Web, an Introduction. *Law and the Semantic Web*, Springer, Vol. 3369, 2005: 1-17.

- García-Sánchez, F., Valencia-García, R., Martínez-Béjar, R. (2005) An integrated approach for developing e-commerce applications. *Expert Systems with Applications*, 28(2):223-235.

3. Government Actions (financial support) for Research Programs on SW

There are no specific support actions for the research on Semantic Web in Spain. However, Semantic Web projects are being funded under other more general disciplines as knowledge-based systems in the main R&D actions, such as CICYT and PROFIT projects.

A request for the creation of a Spanish thematic network on Semantic Web has been recently made to the Spanish Ministry of Education and Science

4. Local Events on SW in Spain

This report is based on the discussions of the workshop "Ontologías y Web Semántica 2005", held on November 14th, 2005, in conjunction with the Spanish Artificial Intelligence Conference (CAE-PIA2005), in Santiago de Compostela. Other related events held in 2005 are the following:

- JSWEB 2005. I Jornadas Científico-Técnicas en Servicios Web. Granada, 13-14 September 2005. Workshop organised by the W3C Spanish office.

- "Gestión Inteligente de Contenidos: la Web Semántica". Barcelona, 30 November 2005. Seminar organised by ISOCO.

- "Gestión Inteligente de Contenidos: la Web Semántica". Madrid, 5 October 2005. Seminar organised by ISOCO.

- "Los Semantic Web Services - Futuro y aplicaciones industriales".

Enrico Motta, Richard Benjamins. Madrid, 20 October 2005. Seminar co-organised by UPM and Fundación de la Innovación Bankinter.

It is also important to highlight that all the editions of the OntoWeb and KnowledgeWeb Summer School on Ontological Engineering and the Semantic Web (SSSW03, SSSW04, SSSW05 and SSSW06) have been held in Cercedilla, Spain, hosted by Universidad Politécnica de Madrid. Finally, several conferences related to the area have taken place in Spain and/or being co-organised by Spanish researchers in the last years, as follows:

- 4th International Semantic Web Conference (ISWC2006). Galway, Ireland. November 6-10 2005. Richard Benjamins was the Industrial Track chair.

- 2nd European Semantic Web Conference (ESWC2005). Hersonissos, Crete, Greece. May 29 - June 1, 2005. Asunción Gómez-Pérez was the programme chair.

- 8th International Protégé Conference. Madrid, Spain. July 18-21 2005.

- International Conference on Web Engineering 2003 (ICWE 2003). Oviedo, Spain, July 14-18, 2003.

- 13th European Conference on Knowledge Engineering and Knowledge Management (EKAW 2002). Sigüenza, Spain, October 1-4, 2002.

5. Semantic Web Industry in Spain

As of 2005, 2006 the Semantic Web is increasingly attracting more interest from industry and the public at large. The Semantic Web effort in Spain started around early 2000 lead by the Universidad Politecnica de Madrid (UPM) and Intelligent Software Components, S.A. (iSOCO). Both organizations were involved in several pioneering European Research Projects, such as IBROW, MKBMEEM, Esperanto, Ontoweb and SWWS. Since then, activity has increased significantly.

From an industry point of view, there are two interesting trends happening: 1) industries are creating teams of experts in the Semantic Web to investigate the possibilities of this technology, and

2) early adopter industries are starting to begin pilot project with Semantic Web technology to solve business problems.

In the first category organizations include¹:

- Private companies
 - o ISOCO (<http://www.isoco.com/>).
 - o Atos Origin (<http://www.atosorigin.es/>).
 - o Arcelor (<http://www.arcelor.com/>).
 - o Software AG (<http://www.softwareag.com/es/default.asp>).
 - o Ándago (<http://www.andago.com/>).
 - o Telefonica I+D (<http://www.tid.es/>).
 - o SHS Polar (<http://www.polar.es/>).
- Non-profit organisations and R&D centres:
 - o Robotiker (<http://www.robotiker.com/>).
 - o IBIT (Illes Balears Innovació Tecnològica, <http://www.ibit.org/home/index.php>).
 - o LABEIN-Tecnalia (<http://www.labein.es/>).
 - o CTIC (<http://www.fundacionctic.org/>).

In the second category organizations include:

- Bankinter (<http://www.ftforum.org/>).
- Residencia de Estudiantes (<http://www.residencia.csic.es/>).
- Real Instituto Elcano (<http://www.realinstitutoelcano.org/default.asp>).
- City of Zaragoza (<http://www.ayto-zaragoza.es/>).

6. Semantic Web Education in Spain

There are several Spanish universities that offer MSc and PhD courses on areas related to the Semantic Web, including topics like knowledge acquisition and representation, Ontological Engineering, Semantic Web Services, etc.

Below we provide a list of the courses available, together with some information about each of them:

¹ We have made our best efforts to provide a list that is as complete as possible, although there may be omissions.

6.1 PhD courses

Universidad Autónoma de Madrid (UPM) offers a PhD programme in Computer Science and Telecommunication at the Polytechnical Engineering School, which includes a course on "Semantic Web"². Started in 2001 with an average of 15 students, this course provides a thorough overview of Semantic Web technologies, including languages, tools, theories, and specialized areas.

Universidad Carlos III de Madrid (UC3M) offers a PhD programme on Communication Technology in its Polytechnical School. As part of this programme, a course on "Management of Multimedia Information in the Internet"³ is taught, with 3 students on average, covering several areas of Ontological Engineering (ontology languages, KR formalisms) and the Semantic Web (annotation).

Universidad de Alcalá (UAH) offers a PhD programme on Information, Documentation and Knowledge⁴ in the Computer Science School. As part of this programme, two courses are taught on SW-related disciplines: Personalization and Usability in Hypermedia and Automatic Composition of Web Services, where SW technologies for personalization and Semantic Web Services are explored respectively. Besides, a seminar is given on the introduction to description logics and the Semantic Web. Approximately 15 students attend these courses, which have been taught since course 2004/05.

Universidad de Extremadura (UEX) offers a PhD programme on Information Technology, Signals and Communications in its Polytechnical School. In the context of this programme, a course on "Ontological Engineering for the Semantic Web"⁵ is taught, with 8 students on average. This course has been taught since 2003.

Universidad de Murcia (UM) offers a PhD programme in Computer

Science at the Computer Science School, which includes a course in knowledge technologies⁶, started in 2003 with an average of 8 students.

Universidad de Oviedo (UniOvi) has been offering a PhD degree titled "Advances in Computer Science" which contains a course on "Web Engineering" from 2002 with 12 students on average. That course contains topics on Web technologies and Semantic Web.

Universidad de Santiago de Compostela (USC) offers a PhD programme on Information Technology in its Faculty of Physics. As part of this programme, a course on "Knowledge Engineering"⁷ is taught, with 5 students on average, covering areas like ontologies and problem solving methods.

Universidad de Valladolid (UVA) offers a PhD programme on "Computer Science", which includes a course on "Semantic Web" since 2004 with an average of 2 students.

Universidad de Zaragoza (UNIZAR) offers a PhD programme on System Engineering and Computer Science at the Polytechnical School, which includes a course on "Distributed Information Systems", started in 2000 with an average of 6 students. This course covers different areas concerning management and access to ontologies, description logics, web services, semantic web, etc.

Universidad del País Vasco (UPV-EHU) offers a PhD programme on "Web Information Systems", which includes a course on "Semantic Web Introduction", started in 2004 with an average of 7 students.

Universidad Nacional de Educación a Distancia (UNED) offers a PhD programme in Computer Science Languages and Systems in the Faculty of Computer Engineering. In it, a course called "Methods and Tools for Knowledge Representation"⁸ is taught. This course, with 12 students on average, has been

taught since 1992, contains topics related to Ontological Engineering.

Universidad Politécnica de Madrid (UPM) is offering SW-related PhD courses in two of its schools: Telecommunications and Computer Science. The course at the Telecommunications School, called "Arquitecturas de bases de datos web. Ontologías para la web semántica"⁹, has normally around 10-12 students. It contains topics about ontologies and Semantic Web languages, database interoperability and heterogeneous database integration and Semantic Grid. The course at the Computer Science School is taught in the context of the Artificial Intelligence Department. It is called "Ontologías y Web Semántica"¹⁰ and it has normally around 15 students. It contains topics about Ontological Engineering, including methodologies, tools and languages, and also describes applications in the context of the Semantic Web. This last course has been taught since 1996.

Universidad Politécnica de Valencia (UPV) offers a PhD programme on "Declarative Programming and Programming Engineering", which includes a course on "Digital Libraries", started in 2005 with an average of 5 students.

6.2 MSc courses

Universidad de Granada (UGR) has recently proposed a MSc where there are two SW-related courses, on Ontologies and on Workflows and Semantic Web Services. This MSc is pending approval.

Universidad de Oviedo (UniOvi) has recently proposed a MSc titled "Web Engineering" with two courses called "Semantic Web" and "Advances in Semantic Web". The first course will be an introductory course with a practical approach, while the second one is more advanced and will cover research topics in Semantic Web. This MSc will start on October 2006.

² <http://www.ii.uam.es/~castells/docencia/semanticweb>

³ <http://www.uc3m.es/uc3m/gral/TC/ESDO/esdo08gimi.html>

⁴ <http://www.uah.es/postgrado/PROGDOCTORADO/>

⁵ <http://quercusseg.unex.es/adolfo/iows/>

⁶ <http://www.um.es/informatica/estudios/programas/II/00CR.pdf>

⁷ http://www.dec.usc.es/doctorado/2005-2007/programa/per_docencia/s16.htm

Universidad de Zaragoza (UNIZAR) offer a MSc programme on "Web Services, Computer Science Security and Applications of E-Commerce" since 2003, with an average of 14 students. This MSc contains a course on "Semantic Web."

Universidad Politécnica de Madrid (UPM) also offers SW-related MSc courses in the aforementioned schools, though none of these courses are exclusively focused on Ontologies and Semantic Web, but on more general aspects like databases¹¹ and Artificial Intelligence¹² respectively. Furthermore, the Technical Computer Science School offers a 3rd year course on Intelligent Agents¹³, which has been taught for three years with 20 students on average. This course contains topics like a basic introduction to the Ontologies and the Semantic Web and a description of ontology markup languages.

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⁸ <http://www.lsi.uned.es/doctorado/1101003.php>

⁹ <http://sinbad.dit.upm.es/docencia/doctorado.html>

¹⁰ http://www.dia.fi.upm.es/doctorado/ia/assignaturas/ontologias_y_la_web_semantica.htm

¹¹ <http://sinbad.dit.upm.es/docencia/grado.html>

¹² http://www.dia.fi.upm.es/licenciatura/assignaturas96/inteligencia_artificial.htm

¹³ <http://www.sia.eui.upm.es/~jbarrasa/teaching/>

Internet Reference Points

1. Ontologías y Web Semántica 2005. http://www-gsi.dec.usc.es/caepia05/workshop_OWS.html, [28.02.2006]
2. Proceedings of the workshop "Ontologías y Web Semántica 2005".
<http://www.cs.man.ac.uk/~ocorcho/documents/ProceedingsWebSemantica2005.pdf>, [28.02.2006]
3. Presentations at the workshop "Ontologías y Web Semántica 2005",
<http://www.cs.man.ac.uk/~ocorcho/Workshops/CAEPIA2005/>, [28.02.2006]
4. JSWEB 2005. <http://www.w3c.es/Eventos/ServiciosWeb/>, [28.02.2006]
5. Revista Novática, special edition on Semantic Web. Nov-Dec 2005.
<http://www.ati.es/novatica/2005/178/nv178sum.html>, [28.02.2006]
6. SSSW05. <http://babage.dia.fi.upm.es/sssw05/>, [28.02.2006]

Press releases

7. El País, 02.02.2005, José Manuel Alonso, W3C España: "La web semántica despegará en 2005",
http://www.elpais.es/articulo/elpportec/20050202elpepnet_1/Tes/, [28.02.2006]
8. El País, 28.04.2005, Ivan Herman: "La buscadores actuales buscan pero no entienden",
http://www.elpais.es/articulo/elpportec/20050428elpepnet_4/Tes/, [28.02.2006]
9. El País, 06.10.2005, Las empresas españolas comienzan su inmersión en la Web semántica,
http://www.elpais.es/articulo/elpportec/20051006elpepnet_2/Tes/, [28.02.2006]
10. El Heraldo de Aragón, 07.03.2006, La Web Semántica es una revolución, <http://www.heraldo.es/> [15.03.2006]

Spanish Semantic Web mailing lists

- semweb-spain@delicias.dia.fi.upm.es [28.02.2006]
- web-semantica-ayuda@es.tldp.org [28.02.2006]