Abstract. Language resources are necessary for language processing, but building them is costly, involves many researches from different areas and needs constant updating. In this paper, we describe the cross-lingual framework used for developing the Multilingual Central Repository (MCR), a multilingual knowledge base that includes wordnets of Basque, Catalan, English, Galician, Portuguese, Spanish and the following ontologies: Base Concepts, Top Ontology, WordNet Domains and Suggested Upper Merged Ontology. We present the story of MCR, its state in 2017 and the developed tools.

Keywords: Language Resources · Knowledge Bases · Wordnets · Basque, Catalan, English, Galician, Portuguese, Spanish · Ontologies

1 Introduction

Building large and rich knowledge bases and language resources is a very costly effort which involves large research groups for long periods of development. For instance, hundreds of person-years have been invested in the development of wordnets for various languages \[16,36,35,30\]. In the case of the English WordNet, in more than ten years of manual construction (from 1995 to 2006, that is, from version 1.5 to 3.0), WordNet grew from 103,445 to 235,402 semantic relations\[4\], which represents a growth of around one thousand new relations per month.

This is also the case of the Iberian wordnets developed and integrated into the Multilingual Central Repository\[5\].

This paper describes the cross-lingual framework used for developing the Multilingual Central Repository (MCR). Currently, the MCR uses WordNet 3.0 as Interlingual-Index (ILI) and integrates in the same EuroWordNet framework wordnets from six different languages: English, Spanish, Catalan, Basque,
Galician and Portuguese. In order to provide ontological coherence to all the integrated wordnets, the MCR has also been enriched with a disparate set of ontologies: Base Concepts, Top Ontology, WordNet Domains and Suggested Upper Merged Ontology. The whole content of the MCR is freely available under the original WordNet license for the English and CC BY 3.0 for the others.

2 A brief history of the MCR

The Multilingual Central Repository (MCR)\(^6\), which follows the model proposed by the EuroWordNet project (LE-2 4003)\(^7\), is the result of the MEANING project (IST-2001-34460)\(^8\), as well as projects KNOW (TIN2006-15049-C03-01), KNOW2 (TIN2009-14715-C04)\(^9\) and several complementary actions associated to the KNOW\(^2\) project. The original MCR was aligned to the 1.6 version of WordNet. In the framework of the KNOW\(^2\) project, we decided to upgrade the MCR to be aligned to a most recent version of WordNet.

The previous version of the MCR was aligned to the English 1.6 WordNet version, it also integrated the eXtended WordNet project\(^{10}\), large collections of selectional preferences acquired from SemCor\(^{11}\) and different sets of named entities\(^{12}\). It was also enriched with semantic and ontological properties as Base Level Concepts,\(^{13}\) Top Ontology,\(^{6}\) SUMO\(^{24}\) or WordNet Domains\(^9\).

The new MCR integrates wordnets of six different languages, including English, Spanish, Catalan, Basque, Galician and Portuguese. This paper presents the work carried out to upgrade the MCR to new versions of these resources. By using technology to automatically align wordnets\(^{12}\), we have been able to transport knowledge from different WordNet versions. Thus, we can maintain the compatibility between all the knowledge bases that use a particular version of WordNet as a sense repository.

However, most of the ontological knowledge has not been directly ported from the previous version of the MCR. Furthermore, WordNet Domains was generated semi-automatically and has never been verified completely. Additionally, it was aligned to WordNet 1.6.

Thus, one goal of this work is the automatic construction of a new semantic resource derived from WordNet Domains and aligned to WordNet 3.0.

Exactly and briefly, the most important changes introduced in this new version of the MCR are:

- The Portuguese WordNet (PULO) developed at the University of Minho
- New variants for Spanish, Catalan, Basque and Galician wordnets
- New encoding for the MCR relations
- A new version of Base Level Concepts (BLC)
- Correcting minor mistakes.

\(^6\) http://adimen.si.ehu.es/web/MCR

\(^7\) http://ixa.si.ehu.es/know

\(^8\) http://ixa.si.ehu.es/know2

\(^9\) http://wndomains.fbk.eu/
2.1 Languages in the MCR

As already mentioned, the MCR includes wordnets for six languages: English, Spanish, Catalan, Portuguese, Galician and Basque. The English wordnet is included directly from the PWN and it serves as a reference for the synsets.

Four of the remaining languages, namely Spanish, Catalan, Portuguese and Galician, are Romance languages derived from Latin and share a lot of linguistic characteristics. On the other hand, Basque is an isolated language and is unrelated to any known living language. By contact with neighbor languages, Basque has adopted words from Latin, Spanish and Gascon, but these words have suffered changes due to Basque phonology and grammar.

Regarding the creation of the wordnets for these languages, the first version of Spanish WordNet (1.5) [20,15] was build during the EuroWordNet project (Vossen, 1998). It was built following the expand model: namely, WordNet synsets were translated into equivalent synsets in Spanish exploiting several Spanish-English bilingual dictionaries and following an automatic method. Then, it was upgraded to versions 1.6 [8] and 3.0 [18]. To build the Catalan Wordnet [10] the methodology which was applied to Spanish WordNet was followed. The Basque wordnet was created both following manual and semi-automatic approaches [28] in the 1.6 versions and then upgraded. Similar to Basque the Galician wordnet [17] was built following manual and semi-automatic approaches but in the 3.0 version. Finally, the PULO Portuguese wordnet [33] was bootstrapped from dictionaries and the English, Galician and Spanish wordnets.

2.2 Ontologies in the MCR

In the MCR there are some ontologies and hierarchies. Following, we present the main features of them.

Basic Level Concepts (BLC) are those concepts that are frequent and salient; they are neither overly general nor too specific. They try i) to represent as many concepts as possible (abstract concepts) and ii) to represent as many distinctive features as possible (concrete concepts).

The EuroWordNet top-ontology (TO) is a lattice structure of 63 features that can be combined in feature combinations. It was designed as an independent hierarchy of features for clustering, comparing and exchanging concepts across languages in the EuroWordNet Project. Its first level is divided in three parts: 1stOrderEntity for physical things, 2ndOrderEntity for events, states and properties and 3rdOrderEntity for unobservable entities.

The Suggested Upper Merged Ontology (SUMO) is an ontology is a standard upper ontology that promotes data interoperability, information search and retrieval, automated inference and natural language processing. SUMO provides also definitions for general purpose terms and consists of a set of concepts, relations, and axioms. Adimen-SUMO [7] is a first-order logic (FOL) ontology obtained by means of a suitable transformation of most of the knowledge (around 88 % of the axioms) in the top and middle levels of SUMO.
WordNet domains is a lexical resource where synsets have been semi-automatically annotated with one or more domain labels from a set of 165 hierarchically organized labels. The aim of this resource is to reduce the level of polysemy of the senses, grouping those senses that belong to the same domain.

3 MCR architecture

The current MCR is stored on a relational database consisting of 46 tables: 1 for the ILI, 30 for the WNs (5 per language), 2 for WordNet Domains, 2 for SUMO, 1 for BLCs, 3 for Top Ontology, 2 for the marks and 5 for define values (relations, groups of relations, colors, counters and semantic files). The most important tables are:

- **wei ili_record** contains the identifier of the ILI.
- **wei xxx-30 to ili, wei xxx-30 relation, wei xxx-30 synset, wei xxx-30 variant** and **wei xxx-30 examples** contain each wordnet: connection to the ILI, the relations, the synsets, the variants and the examples. The xxx indicates the three letter code its language has, which are namely eng, spa, por, gal, cat and eus.
- **wei ili to blc** contains the links of ILI to its BLC’s ILI.
- **wei sumo relations** and **wei ili to sumo** contain the SUMO relations and the links of SUMO label to an ILI.
- **wei to relations, wei ili to to** and **wei to record** indicate the TO hierarchy, the links to the ILIs and the TO labels respectively.

In Figure 1 we show the architecture of the MCR and the connection to the Web EuroWordnet Interface (WEI) that we will present in the following section.

4 MCR tools

In this section we present the tools that have been developed in relation to the MCR.

4.1 Interfaces: WEI and Galnet

The MCR can be consulted in two different interfaces: the one developed in the Web EuroWordnet Interface (WEI) and the Galnet interface.

The WEI interface was developed during the EuroWordNet project and it has both consult and edit mode. For this release the most changes we have made are:

- add links to BabelNet and OWN webpages,
- upgrade visualization of hierarchies,
- add a new version of AdimenSUMO, and
- changed some buttons in edit mode.
The Galnet interface\textsuperscript{10} was designed to query Galnet, the Galician version of WordNet which is part of the MCR, extends the MCR WEI functionalities by providing

- different types of navigation through domain hierarchies and ontologies,
- an interactive tree-based visualization of synsets by their semantic relations,
- temporal values and sentiment scores for synsets from TempoWordNet\textsuperscript{11}, SentiWordNet 3.\textsuperscript{12} and ML-SentiCon\textsuperscript{13},
- images associated to synsets from ImageNet\textsuperscript{14},
- a tool called Termonet specifically designed for the extraction of lexical-semantic fields,
- a terminology-oriented semantic categorization based on epinonyms,
- and a new presentation of information associated with synsets in Linked Open Data format (RDF Galnet).

\textsuperscript{10} http://sli.uvigo.gal/galnet/
\textsuperscript{11} https://tempowordnet.greyc.fr
\textsuperscript{12} http://sentiwordnet.isti.cnr.it
\textsuperscript{13} http://sentiwordnet.isti.cnr.it
\textsuperscript{14} http://www.image-net.org
4.2 Termonet and epinonyms

To explore terminology, the possibilities of building a term-oriented hierarchical structure from all the set of the WordNet synsets were explored. In addition, a method was sought to verify the empirical occurrence of the concepts in specialized corpora.

To that end, Termonet enables the extraction of domain-specific variants from WordNet and provides a query form that allows selecting a synset from the lexical-semantic network and extracting related terms according to the semantic relations defined in the configuration. Although Termonet allows extraction from any WordNet synset, due to its terminological nature, the application always tries to suggest the closest noun variants when initiating a search from a non-noun synset. Termonet’s features rely on two basic resources: a wordnet and a corpus of specialized language.

Research on Termonet has lead us to a new semantic categorization of WordNet devised to exploit the terminological implications of the relations between synsets. The adopted approach was based on tracing a path in the opposite direction to that used by Termonet to explore a domain from a synset, so each synset finds its way through the relations to an epinonym noun synset representing the semantic domain in which to be included automatically. Thus, an epinonym is a noun synset representing the category of the semantic domain to which other synsets will be automatically assigned by algorithms that will evaluate their proximity from a terminological point of view through the cognitive processing of the lexical semantic relations in the network [17].

4.3 RDF versions

Galnet interface also provides all its contents as RDF resources through a SPARQL endpoint[^15] with free public access for users to explore the data using SPARQL queries [^14].

The RDF Galnet monolingual dictionaries conform to the Lemon model[^16]. The Galnet synsets are aligned with Princeton’s WordNet synsets version 3.1, with Princeton’s WordNet synsets version 3.0 in lemonUby[^17] and with the Interlingual Index (ILI). In many cases, Princeton’s WordNet also provides the alignment with a corresponding synset in lemonUby version 3.0. However, the alignment in RDF Galnet offers correspondences between all MCR synsets from version 3.0 and version 3.1 or lemonUby ones.

The RDF Galnet internal ontology is based on the ontology that uses the RDF Princeton Wordnet 3.1, revised and adapted to the EuroWordNet framework followed by the MCR project. Moreover, all the ontologies linked to the Galnet synsets were converted to the RDF data model: Adimen-SUMO, Top

[^15]: [http://sli.uvigo.gal/sparql/](http://sli.uvigo.gal/sparql/)
[^16]: [http://lemon-model.net](http://lemon-model.net)
[^17]: [http://lemon-model.net/lexica/uby/](http://lemon-model.net/lexica/uby/)
Ontology, WordNet Domains and Epinonyms. Turtle files with data corresponding to the latest public release of the dataset and related ontologies can also be downloaded from Galnet site.18

4.4 The WN-Toolkit

The expansion of the Spanish, Catalan and Galician wordnets in the MCR has been partially performed using the WN-Toolkit19 [25]. This is a set of programs and data sets for the automatic creation of wordnets following the expand model, that is, by the translation of English variants from synsets of the PWN. The toolkit implements several strategies:

– Dictionary based methodology using bilingual dictionaries. The direct translation of English variants can be only done for monosemic variants, that is, variants assigned to a single synset. For polysemic variants several strategies have been developed to use the definitions in WordNet and the lexical resource in order to select the correct alignment. Within the toolkit, several alignments between PWN and some free lexical resources (namely Wikipedia, Wiktionary and Omegawiki) have been published.
– Using old versions of BabelNet [23], where relations between PWN and Wikipedia are provided.
– Parallel corpus based methodologies. For this methodology the corpus should be semantically tagged with PWN synsets. As these corpora are not easily available, two strategies have been used:
  • Machine translation of sense-tagged corpora
  • By automatic sense-tagging of the English part of available English-target language parallel corpora.

The WN-Toolkit has been successfully use to enlarge other wordnets, as for example the Croatian wordnet [20].

The future development of this toolkit is oriented to the creation of reliable alignments between wordnets and Wikipedia, Wiktionary and Omegawiki. These alignments will allow the creation of new wordnets and the expansion of existing ones.

4.5 UKB: Graph Based Word Sense Disambiguation and Similarity

One of the most well-known Word Sense Disambiguation (WSD) tool is UKB [2], which is a collection of programs for performing graph-based WDS. Using pre-existing knowledge bases (KB) like wordnets in MCR, UKB applies random walks, e.g. Personalized PageRank, on the KB graph to rank the vertices according to the given context. UKB can be used together with the Ixa-pipes [1], a modular set of NLP tools (or pipes) for several languages, in order to perform WSD.

18 http://sli.uvigo.gal/download/SLI_Galnet/
19 http://sourceforge.net/projects/wn-toolkit/
5 Current state of the MCR

The MCR is actively maintained and the wordnets in the MCR are still under continuous development in order to enlarge and improve them. The latest distribution of MCR was done in 2016 can be downloaded from [http://adimen.si.ehu.es/web/MCR/](http://adimen.si.ehu.es/web/MCR/) but regular updates can be consulted in the interface.

Following we show the statistics for the Spanish, Catalan, Portuguese, Galician and Basque wordnets included in the MCR in the latest distribution. In Table 1 we present the main statistics for all the languages, where Core % is the percentage of core synsets covered; CILI % is the percentage of synsets linked to CILI; and Def and Ex % are the percentages of synsets with definitions and examples respectively.

| Lang | Sp | Ca | Po | Ga | Eu |
|------|----|----|----|----|----|
| Synsets | 38,512 | 45,826 | 15,608 | 40,975 | 29,413 |
| Words | 37,203 | 47,598 | 8,471 | 50,702 | 26,390 |
| Forms | 37,203 | 47,598 | 8,471 | 50,702 | 26,390 |
| Senses | 57,764 | 70,622 | 21,244 | 64,338 | 48,934 |
| Core % | 76.0 | 81.0 | 64.3 | 74.7 | 70.5 |
| CILI % | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Def % | 0.0 | 0.0 | 0.0 | 21.3 | 0.0 |
| Ex % | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

Table 1: Main Statistics for MCR 3.0 (2016)

Following, we show the PoS statistics for each of the wordnets in Table 2

| Lang | PoS | Synsets % | Words % | Senses % |
|------|-----|----------|---------|----------|
| Sp   | Noun | 26,404 68.6 | 28,647 77.0 | 38,917 67.4 |
|      | Verb | 6,251 16.2 | 4,354 11.7 | 10,829 18.7 |
|      | Adjective | 5,180 13.5 | 3,289 8.8 | 6,967 12.1 |
|      | Adverb | 677 1.8 | 913 2.5 | 1,051 1.8 |
| Ca   | Noun | 36,253 79.1 | 38,733 81.4 | 51,364 72.7 |
|      | Verb | 5,424 11.8 | 4,633 9.7 | 11,577 16.4 |
|      | Adjective | 4,148 9.1 | 4,230 8.9 | 7,679 10.9 |
|      | Adverb | 1 0.0 | 2 0.0 | 2 0.0 |
| Po   | Noun | 8,750 56.1 | 5,057 59.7 | 11,760 55.4 |
|      | Verb | 3,200 20.5 | 1,418 16.7 | 4,840 22.8 |
|      | Adjective | 3,175 20.3 | 1,582 18.7 | 4,118 19.4 |
|      | Adverb | 483 3.1 | 414 4.9 | 526 2.5 |
| Ga   | Noun | 31,163 76.1 | 39,617 78.1 | 46,634 72.5 |
|      | Verb | 3,212 7.8 | 4,079 8.0 | 7,237 11.2 |
|      | Adjective | 5,526 13.5 | 5,801 11.4 | 8,823 13.7 |
|      | Adverb | 1,074 2.6 | 1,123 2.2 | 1,644 2.6 |
| Eu   | Noun | 25,938 88.2 | 22,877 86.7 | 39,535 80.8 |
|      | Verb | 3,364 11.4 | 3,456 13.1 | 9,251 18.9 |
|      | Adjective | 111 0.4 | 57 0.2 | 148 0.3 |

Table 2: PoS Statistics for wordnets in MCR 3.0 (2016)
6 Concluding Remarks and Future Plans

In this paper we have presented the Multilingual Central Repository (MCR), a large scale knowledge base on continuous development since 2002. Currently, the MCR includes wordnets of six different languages (English, Spanish, Catalan, Basque, Galician and Portuguese) and ontological knowledge provided by the Basic Level Concepts, the EuroWordNet top-ontology, SUMO and WordNet domains.

From now on, we plan to apply advanced deep learning techniques for building automatically large-scale wordnets from scratch from any language and domain. We want to explore novel deep learning approaches and methods for acquiring general and specialized large-scale lexical knowledge from textual corpora. The domains that will be specially targeted are eHealth, eLearning, eTourism and eJustice. This task covers the exploitation of word and sense embeddings for creating new synsets in order to include new concepts for all the MCR languages based on the Collaborative ILI. Additionally, existing glosses will be also translated by means of supervised and unsupervised Neural Machine Translation techniques.

Moreover, we will integrate the semantic categorization based on epinonyms into the MCR and the Predicate Matrix [13], a new lexical resource resulting from the integration of multiple sources of predicate information including FrameNet [9], VerbNet [31], PropBank [27], WordNet [16], Basque Verb Index [14] and ESO [32].

Finally, by leveraging information from textual data and existing knowledge bases and ontologies, we would like to address a very difficult challenge in text mining: checking the veracity of answers based on external sources such as the MCR.

Acknowledgments

This research has been carried out thanks to the project DeepReading (RTI2018-096846-B-C21) supported by the Ministry of Science, Innovation and Universities of the Spanish Government.

References

1. Agerri, R., Bermudez, J., Rigau, G.: IXA pipeline: Efficient and Ready to Use Multilingual NLP tools. In: LREC. vol. 2014, pp. 3823–3828 (2014)
2. Agirre, E., de Lacalle, O.L., Soroa, A.: The risk of sub-optimal use of Open Source NLP Software: UKB is inadvertently state-of-the-art in knowledge-based WSD. In: NLP-OSS workshop at ACL (2018)
3. Agirre, E., Martinez, D.: Learning Class-to-class Selectional Preferences. In: Proceedings of the Workshop Proceedings of the Conference on Computational Natural Language Learning (ConLL), Tolouse, France, pp 17-24. (2001)
4. Agirre, E., Rigau Claramunt, G., Castellón, I., Alonso, L., Padró, L., Cuadros Oller, M., Climent Roca, S., Coll-Florit, M.: KNOW: Developing Large-scale Multilingual Technologies for Language Understanding. Procesamiento del lenguaje natural pp. 377–378 (2009)

5. Alfonseca, E., Manandhar, S.: An Unsupervised Method for General Named Entity Recognition and Automated Concept Discovery. In: Proceedings of the 1st international conference on general WordNet, Mysore, India. pp. 34–43 (2002)

6. Álvez, J., Atserias, J., Carrera, J., Climent, S., Laparra, E., Oliver, A., Rigau, G.: Complete and consistent annotation of WordNet using the Top Concept Ontology. In: Calzolari, N., Choukri, K., Maegaard, B., Mariani, J., Odijk, J., Piperidis, S., Tapias, D. (eds.) Proc. of the 6th Int. Conf. on Language Resources and Evaluation (LREC 2008). pp. 1529–1534. European Language Resources Association (ELRA) (may 2008)

7. Álvez, J., Lucio, P., Rigau, G.: Adimen-SUMO: Reengineering an ontology for first-order reasoning. Int. J. Semantic Web Inf. Syst. 8(4), 80–116 (2012)

8. Atserias, J., Villarejo, L., Rigau, G., Agirre, E., Carroll, J., Magnini, B., Vossen, P.: The meaning multilingual central repository. In: Proceedings of the Second International Global WordNet Conference (GWC’04) (2004)

9. Baker, C.F., Fillmore, C.J., Lowe, J.B.: The Berkeley FrameNet project. In: 36th Annual Meeting of the Association for Computational Linguistics and 17th International Conference on Computational Linguistics, Volume 1. pp. 86–90 (1998)

10. Benítez, L., Cervell, S., Escudero, G., Lopez, M., Rigau, G., Taulé, M.: Methods and Tools for Building the Catalan WordNet. In: Proceedings of the ELRA Workshop on Language Resources for European Minority Languages, First International Conference on Language Resources & Evaluation, Granada, Spain (1998)

11. Bentivogli, L., Forner, P., Magnini, B., Pianta, E.: Revising the wordnet domains hierarchy: semantics, coverage and balancing. In: Proceedings of the Workshop on Multilingual Linguistic Resources. pp. 101–108. Association for Computational Linguistics (2004)

12. Daudé, J., Padró, L., Rigau, G.: Making Wordnet Mapping Robust. Procesamiento del lenguaje natural 31 (2003)

13. De Lacalle, M.L., Laparra, E., Aldabe, I., Rigau, G.: Predicate matrix: automatically extending the semantic interoperability between predicate resources. Language Resources and Evaluation 50(2), 263–289 (2016)

14. Estarrona, A., Aldezabal, I., de Illarraza, A.D.: How the corpus-based basque verb index lexicon was built. Language Resources and Evaluation 54(1), 73–95 (2020)

15. Farreres, X., Rigau, G., Rodriguez, H.: Using WordNet for Building Wordnets. In: Proceedings of COLING-ACL Workshop Usage of WordNet in Natural Language Processing Systems (1998)

16. Fellbaum, C. (ed.): WordNet: An Electronic Lexical Database. MIT Press (1998)

17. Gómez Guinovart, X., Solla Portela, M.A.: Building the Galician wordnet: methods and applications. Language Resources and Evaluation 52(1), 317–339 (2018). https://doi.org/10.1007/s10579-017-9408-5

18. González-Agüerre, A., Laparra, E., Rigau, G.: Multilingual central repository version 3.0. In: LREC. pp. 2525–2529 (2012)

19. Izquierdo, R., Suárez, A., Rigau, G.: Exploring the Automatic Selection of Basic Level Concepts. In: Proceedings of the International Conference on Recent Advances on Natural Language Processing (RANLP’07). vol. 7 (2007)

20. J., A., S., C., J., F., G., R., H., R.: Combining Multiple Methods for the Automatic Construction of Multilingual WordNets. In: Proceedings of the International Conference Recent Advances on Natural Language Processing (RANLP) (1997)
21. Magnini, B., Cavaglia, G.: Integrating Subject Field Codes into WordNet. In: Proceedings of LREC. pp. 1413–1418 (2000)
22. Mihalcea, R., Moldovan, D.I.: eXtended Wordnet: Progress Report. In: in Proceedings of NAACL Workshop on WordNet and Other Lexical Resources. Citeseer (2001)
23. Navigli, R., Ponzetto, S.P.: Babelnet: Building a very large multilingual semantic network. In: Proceedings of the 48th annual meeting of the association for computational linguistics. pp. 216–225. Association for Computational Linguistics (2010)
24. Niles, I., Pease, A.: Towards a standard upper ontology. In: Guarino N. et al. (ed.) Proc. of the 2nd Int. Conf. on Formal Ontology in Information Systems (FOIS 2001). pp. 2–9. ACM (2001). [https://doi.org/10.1145/505168.505170]
25. Oliver, A.: Wn-toolkit: Automatic generation of wordnets following the expand model. In: Proceedings of the 7th Global WordNet Conference. pp. 7–15 (2014)
26. Oliver, A., Sojat, K., Srebacic, M.: Enlarging the croatian wordnet with wn-toolkit and cro-deriv. In: RANLP. pp. 480–487 (2015)
27. Palmer, M., Gildea, D., Kingsbury, P.: The proposition bank: An annotated corpus of semantic roles. Computational linguistics 31(1), 71–106 (2005)
28. Pociello, E., Agirre, E., Aldezabal, I.: Methodology and Construction of the Basque WordNet. Language resources and evaluation 45(2), 121–142 (2011)
29. Rigau, G., Magnini, B., Agirre, E., Vossen, P., Carroll, J.: Meaning: A Roadmap to Knowledge Technologies. In: Proceedings of the 2002 COLING workshop: A roadmap for computational linguistics-Volume 13. pp. 1–7. Association for Computational Linguistics (2002)
30. Robkop, K., Thoongsup, S., Charoenporn, T., Sornlertlamvanich, V., Isahara, H.: Wnms: Connecting the distributed wordnet in the case of asian wordnet. In: Principles, Construction, and Applications of Multilingual Wordnets. Proceedings of the Fifth Global WordNet Conference (GWC 2010), India. Narosa Publishing (2010)
31. Schulter, K.K.: VerbNet: A broad-coverage, comprehensive verb lexicon. University of Pennsylvania (2005)
32. Segers, R., Vossen, P., Rospocher, M., Serafini, L., Laparra, E., Rigau, G.: Eso: A frame based ontology for events and implied situations. Proceedings of MAPLEX 2015 (2015)
33. Simoes, A., Guinovart, X.G.: Bootstrapping a Portuguese Wordnet from Galician, Spanish and English Wordnets. In: Advances in Speech and Language Technologies for Iberian Languages. pp. 239–248. Springer (2014)
34. Solla Portela, M.A., Gómez Guinovart, X.: DBpedia del gallego: recursos y aplicaciones en procesamiento del lenguaje. Procesamiento del Lenguaje Natural 57, 139–142 (2016)
35. Tuñís, D., Barbu, E.: A Methodology and Associated Tools for Building Interlingual Wordnets. In: Proceedings of the 4th LREC Conference. pp. 1067–1070 (2004)
36. Vossen, P. (ed.): EuroWordNet. Kluwer (1998)