

# OpenWordNet-PT: An Open Brazilian Wordnet for Reasoning

Valeria de Paiva<sup>1</sup> Alexandre Rademaker<sup>2</sup> Gerard de Melo<sup>3</sup>

(1) School of Computer Science, University of Birmingham, England

(2) Escola de Matemática Aplicada, FGV, Brazil

(3) ICSI, Berkeley, USA

valeria.depaiva@gmail.com, alexandre.rademaker@fgv.br, demelo@icsi.berkeley.edu

## ABSTRACT

Brazilian Portuguese needs a Wordnet that is open access, downloadable and changeable, so that it can be improved by the community interested in using it for knowledge representation and automated deduction. This kind of resource is also very valuable to linguists and computer scientists interested in extracting and representing knowledge obtained from texts. We discuss briefly the reasons for a Brazilian Portuguese Wordnet and the process we used to get a preliminary version of such a resource. Then we discuss possible steps to improving our preliminary version.<sup>1</sup>

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KEYWORDS IN L<sub>2</sub>: Wordnet, Português, recursos léxicos, SUMO.

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## 1 Motivation

WordNet (Fellbaum, 1998) is an extremely valuable resource for research in Computational Linguistics and Natural Language Processing in general. WordNet has been used for a number of different purposes in information systems, including word sense disambiguation, information retrieval, automatic text classification, automatic text summarization, and dozens of other knowledge intensive projects.

We started a project at Fundação Getulio Vargas (FGV) in Brazil, whose goal, in the long run, is to use formal logical tools to reason about knowledge obtained from texts in Portuguese. Originally we had expected to be able to use some existing Brazilian Wordnet, out of the box, but it turns out that these are not available in the form that we need it. There are some attempts.

There is the project WordNet.PT (Portuguese WordNet) from the “Centro de Linguística da Universidade de Lisboa” headed by Prof. Palmira Marrafa. But this is available online only, no download available and, as far as we can see on their webpages, little development has happened recently to this project. The WordNet.PT version available online has about 19000 lexical expressions, from different semantic fields. The fragment made available online includes expressions from subdomains such as art, clothing, geography, health, institutions, living entities and transportation, but no description of other domains and/or future releases of the database are discussed. The group has also a newer version of WordNet.PT called WordNet.PT<sub>global</sub> (Marrafa et al., 2011) which pays attention to different varieties of Portuguese, like African variations of the language. But while this is very interesting for linguistic comparative research and useful for online queries (<http://www.clul.ul.pt/wnglobal/>), this smaller version of WordNet.PT is not available for download and hence cannot be the target of modifications and improvements.

There is also the MultiWordNet project and its Portuguese version MWN.PT, developed by António Branco and colleagues at the NLX-Natural Language and Speech Group, of the University of Lisbon, Department of Informatics. According to their description (<http://mwnpt.di.fc.ul.pt/>), MWN.PT, the MultiWordnet of Portuguese (version 1), spans over 17,200 manually validated concepts/synsets, linked under the semantic relations of hyponymy and hypernymy. These concepts are made of over 21,000 word senses/word forms and 16,000 lemmas from both European and American variants of Portuguese. It includes the sub-ontologies under the concepts of Person, Organization, Event, Location, and Artworks, which are covered by the top ontology made of the Portuguese equivalents to all concepts in the 4 top layers of the English Princeton WordNet and to the 98 Base Concepts suggested by the Global Wordnet Association, and the 164 Core Base Concepts indicated by the EuroWordNet project. But again this wordnet is available online only and with a restrictive license that requires payment.

Finally, there is a first version of a Brazilian Portuguese version of Wordnet developed by Bento Dias da Silva and collaborators (Dias-Da-Silva et al., 2000; Scarton and Aluisio, 2009). But this also cannot be downloaded, is not available online and is not being maintained on an open access basis, which is one of the strongest points of Princeton WordNet.

Open access availability is one of the main reasons we would like to create a new Portuguese Wordnet, which we are calling OpenWordNet-PT (or OpenWN-PT for short). This is because we believe that resources like Wikipedia and WordNet need to be open and modifiable by others in order to improve over time.

With a similar philosophy of open access to ours, there is also the work of Hugo Oliveira

and Paulo Gomes on Onto.PT ((Gonçalo Oliveira et al., 2011)), another lexical ontology for the Portuguese language, structured similarly to Princeton’s WordNet, in the process of development at the University of Coimbra, Portugal. Unlike our own OpenWordNet-PT, Onto.PT is not connected to the synsets in the Princeton WordNet. Due to this, existing Princeton WordNet-focused resources like inter-lingual links in EuroWordNet, mappings to the SUMO ontology and DBpedia/YAGO cannot be used in conjunction with this resource.

## **2 OpenWordNet-PT**

OpenWordNet-PT is being created by drawing on a two-tiered methodology so as to offer high precision for the more salient and frequent words of the language, but also high recall in order to cover a wide range of words in the long tail. We thus combine manual base concept annotation with statistical cross-lingual projection techniques.

### **2.1 Cross-Lingual Projection**

As a starting point, we applied the UWN/MENTA methodology (de Melo and Weikum, 2009, 2010), developed by one of the authors of this paper in conjunction with Gerhard Weikum, to the Portuguese language.

In a first step, the information in the English Princeton WordNet is projected to Portuguese by using translation dictionaries to map the English members of a synset to possible Portuguese translation candidates. In order to disambiguate and choose the correct translations, feature vectors for possible translations are created by computing graph-based statistics in the graph of words, translations, and synsets. Additional monolingual wordnets and parallel corpora are used to enrich this graph. Finally, statistical learning techniques are then used to iteratively refine this information and build an output graph connecting Portuguese words to synsets.

In a second step, Wikipedia pages are linked to relevant WordNet synsets by learning from similar graph-based features as well as gloss similarity scores. Such mappings allow us to attach the article titles of the Portuguese Wikipedia with WordNet synsets, thus further increasing the coverage.

### **2.2 Base Concept Annotation**

Using cross-lingual projection, we obtain a resource with good coverage. In order to have high precision for the most important concepts of a language, we rely on human annotators.

In particular, we decided to rely on a set of Base Concepts. The Global WordNet Association aims at the development of wordnets for all languages of the world and to extend the existing wordnets to full coverage and many parts-of-speech. In 2006, the association launched a project to start building a completely free worldwide wordnet “grid”. This grid would be built around a shared set of concepts, which would be expressed in terms of the original Wordnet synsets and SUMO (Niles and Pease, 2001) terms.

The vision of a global grid of wordnets in many languages that draw on a common set of concepts is very appealing, as it enables many cross-lingual applications. The suggestion of the Global WordNet Association is to build a first version of the grid around the set of 4689 “Common Base Concepts” and to make the grid free, following the example of the Princeton WordNet. The Base Concepts are supposed to be the most important concepts in the various wordnets of different languages. The importance of the concepts was measured in terms of two

main criteria: (1) A high position in the semantic hierarchy; (2) Having many relationships to other concepts. The procedure described as the EuroWordNet “expand approach” seemed sensible: First translate the synsets in the Princeton WordNet to Portuguese, then take over the relations from Princeton and revise, adding the Portuguese terms that satisfy different relations. Then we hope to revise thoroughly to guarantee the consistency of the taxonomy and to make sure that all lexical items with a heavy use in Portuguese were described. This process is under development at the moment. Currently, Portuguese annotators are revising the base concepts by manually choosing appropriate Portuguese words and by manually writing appropriate Portuguese gloss descriptions.

## 2.3 Project Status

OpenWordNet-PT is freely available as an open-source project<sup>2</sup>. The data is also available for online browsing<sup>3</sup> via the online interface developed by Francis Bond (Bond and Paik, 2012). This interface, depicted in Fig. 1, is particularly insightful, as it displays Portuguese entries in conjunction with entries in several other languages given by other open-source wordnet projects.

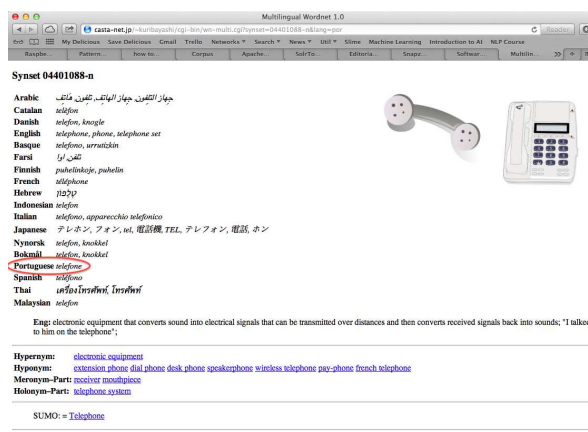


Figure 1: Francis Bond’s Open Multilingual Wordnet website

In total, our resource has 62,034 sense-word pairs, and 45,421 unique words. These include 2,498 manually entered sense-word pairs as well as an additional 1,299 manually written Portuguese synset glosses. Additional statistics regarding the lexical coverage are provided in the appendix.

The raw coverage seems reasonable in number of terms in the ontology, but we need to make sure that the quality of the items is comparable and in particular that the level of detail is approximately the right one for our intended application.

<sup>2</sup><https://github.com/arademaker/wordnet-br/>

<sup>3</sup><http://casta-net.jp/~kuribayashi/cgi-bin/wn-multi.cgi>

## 3 Perspectives

### 3.1 OpenWordNet-PT and SUMO

We started from an informal project discussing how logic and automated reasoning could have a bigger impact, if coupled with natural language processing. We also wanted to make sure that we could obtain some (ideally most) of the advances already made for English text understanding to Portuguese text understanding and reasoning.

Building on previously developed technology, like the Xerox PARC XLE (Xerox Language Engine) system and trying to adapt that system to Brazilian Portuguese seemed a good idea. However, the AI and logic components of the system come at the end of a long pipeline of modules which require expertise on processing of natural language. In particular we felt that a Brazilian Portuguese version of WordNet that could be freely distributed to others was an essential part of it.

Wordnet is an important component of the XLE Unified Lexicon (UL (Crouch and King, 2005)), as the logical formulae created by the Abstract Knowledge Representation (AKR) component of the system are given meaning, in terms of Wordnet synsets. A previous version of the system used, instead of the Unified Lexicon, the proprietary Cyc (Lenat, 1995) concepts as semantics. As discussed in (De Paiva et al., 2007) the sparseness of Cyc concepts was the main reason to move away from Cyc onto a version of the Bridge system based on the unified lexicon and WordNet.

Having a Brazilian version of WordNet and a mapping from Portuguese words to that would allow us to use a knowledge representation system very similar to the AKR (Abstract Knowledge Representation) used in the PARC Bridge system. Having our version of the Portuguese WordNet based on basic concepts we hope to leverage the huge manual construction effort which constitutes the mapping from WordNet to SUMO (Niles and Pease, 2003).

Through a partnership with Adam Pease, (the technical editor of SUMO), we additionally intend to use the SUMO hierarchy to check the consistency between the Portuguese version of WordNet and the English one.

### 3.2 Intended Application

The main application we envisage for our work in OpenWordNet-PT is related to the entries in the Brazilian Dictionary of Historical Biographies (in Portuguese DHBB), one of the main knowledge resources implemented as a result of the archival efforts of the Fundação Getulio Vargas. The DHBB consists of 7,553 dictionary entries, out of which 6,584 are biographies of important politicians in Brazil's recent history. There are also 969 topical entries, concerning institutions, events and descriptions relating to the history and economy of Brazil after 1930. The dictionary is available online, but since the project was started in the 1970s the information is not properly linked, which makes querying its data somewhat unwieldy.

We intend to process all of the DHBB entries and we plan to extract from them the main SUMO concepts referenced. Using these main SUMO concepts we want to bootstrap a fledgeling Ontology of Historical Biographies, already started and documented in the Development section of SUMO. From the analysis of the SUMO concepts uncovered in the biographical entries, we want to discover new relationships between the historical characters described in the DHBB.

Here are some examples of the kinds of questions that this association of text of biography

entry with collections of SUMO concepts will allow us to answer: (1) Amongst Brazilian first rank politicians how many are from São Paulo? (2) Has the proportion of Paulistas increased or decreased since the 1930s? Since 1965 when Brasilia became the Capital of Brazil has the proportion changed? (3) What are the important Brazilian political families, corresponding to the Kennedys, the Bushs, etc? (4) What are the prevalent occupations among Brazilian historical figures? Are they mostly lawyers by training?

## 4 Conclusion

OpenWordNet-PT combines high recall with high precision for the more salient words in the language. The work in this project is only starting, but we have many plans to measure and increase the quality of the Portuguese lexical resource, as well as many plans to use the resource in its current form. The data is freely available for download as well as for online browsing.

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## A Some OpenWordNet-PT Statistics

In Table 1, columns 1-3 numbers by POS are: (1) word-sense-pairs; (2) unique words/terms; and (3) synsets with portuguese words. Columns 4-6 present averages of polysemy and senses by POS: (4) the average polysemy (number of senses per word, tot avg. 1.3658); (5) the average polysemy excluding monosemous, (number of senses per word excluding words with only one sense, tot. avg. 3.0100); and (6) the average number of sense lexicalizations excluding unlexicalized (number of words per synset for those synsets that have at least one Portuguese word, tot. avg. 1.4836).

	(1)	(2)	(3)	(4)	(5)	(6)
Nouns	45,751	31,438	35,869	1.2755	2.9681	1.4553
Verbs	7,155	4,265	3,724	1.9213	3.9200	1.6776
Adjectives	7,402	5,193	4,996	1.4816	2.8145	1.4254
Adverbs	1,726	917	1,305	1.3226	2.3849	1.8822
Total	62,034	41,813	45,421			

Table 1: The size of OpenWN-BR and averages about polysemy and senses

In Table 2, column (1) shows the number of relations from Princeton WordNet where either source or target synset have a Portuguese lexicalization. Column (2) shows the number of relations from Princeton WordNet where both source and target synset have a Portuguese lexicalization.

	(1) Source or Target	(2) Source and Target
hypernymy	68,002	22,002
instance-of/has-instance	7,899	4,540
part meronymy	7,964	4,247
member meronymy	8,591	2,802
substance meronymy	637	332
has-category	6,494	2,213
cause	163	76
entailment	370	162
similar	13,998	3,524
closely-related	2,595	1,117
attribute	1,068	516
antonym	4,907	1,863

Table 2: Relations from Princeton WordNet

