

English WordNet 2019 – An Open-Source WordNet for English

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Abstract

We describe the release of a new wordnet for English based on the Princeton WordNet, but now developed under an open-source model. In particular, this version of WordNet, which we call English WordNet 2019, which has been developed by multiple people around the world through GitHub, fixes many errors in previous wordnets for English. We give some details of the changes that have been made in this version and give some perspectives about likely future changes that will be made as this project continues to evolve.

1 Introduction

WordNet (Miller, 1995; Fellbaum, 1998) is one of the most widely-used language resources in natural language processing and continues to find usage in a wide variety of applications including sentiment analysis (Wang et al., 2018), natural language generation (Juraska et al., 2018) and textual entailment (Silva et al., 2018). However, in the recent few years there has been only one update since version 3.0 was released in 2006, in spite of its wide use and the interest in the data. In the meantime, a number of other wordnet teams working with the WordNet data have proposed modifications or extensions to its latest release. These two facts have provided the chief motivation for our present initiative, namely developing an open-source WordNet for English on the basis of Princeton WordNet (to be released under the name English WordNet 2019).

In order to allow for meaningful comparisons of performance on tasks using WordNet as a component, it is important to maintain a single (or very few) wordnets as a standard and reference.

One of the core issues preventing further development of the original WordNet model has been the question of how to ensure the resource maintains its quality. The Princeton WordNet team has

followed a model that requires an expert lexicographer to review and implement all changes. In this paper, we discuss the development of Open English WordNet, which instead follows a methodology of quality assurance that is based on those typically used for open-source projects, especially those connected to the Linux operating system. In particular, we can consider this to be an application of Linus’s Law (“given enough eyeballs, all bugs are shallow”) to the development of WordNet, similar to other open source orientated projects such as OpenWordNetPT (Paiva et al., 2012) and the recently announced Global FrameNet project¹. Still, we will do our best to make new data or proposed changes verified by expert lexicographers or developers whenever possible.

We have implemented this in terms of a new ‘fork’ of Princeton WordNet, and have released a new version of WordNet that fixes many of (mostly trivial) errors, such as spelling mistakes, and thus improves the quality of the resource. We take inspiration from other forks such as the MariaDB fork of MySQL and aim to make this a ‘drop-in’ replacement for Princeton WordNet. This is achieved by ensuring that that data is available in a wide range of formats, including those used by Princeton to publish the resource and standards promoted by the Global WordNet Association so that existing projects can use these changes without updates to their workflows. In particular, we continue to follow the basic conception of Princeton WordNet and do not introduce changes that would fundamentally affect the nature of the wordnet. Instead, our focus for this release is on fixing more minor errors and for future releases we plan to extend this to principally adding new synsets and relations, using the existing structure

¹<https://www.globalframenet.org/>

as a guide. As an open-source project we expect that the community will create synsets that reflect their views, and that this may in the long run lead to more significant divergences from the Princeton WordNet model,

Moreover, we also present a new website and project that allows the resources to be queried at <http://en-word.net>, which presents the most recent changes in a dynamic manner as they are updated on the GitHub website. To indicate that this is a clearly new version of WordNet we have termed this version the 2019 edition of English WordNet and provide a clear and auditable list of changes that have been made such that it would be possible for the Princeton WordNet to use these changes in any future versions they make.

This paper is structured as follows: first, we will present some other efforts to extend the Princeton WordNet for English and then we will describe the kinds of changes that we have made for this release. We will then provide a brief discussion of the open issues that will be handled in the next version and how they may be handled. We will then briefly describe the release and the implementation of the user interface.

2 Background

Princeton WordNet (Miller, 1995; Fellbaum, 2010) is the first wordnet for English, however it is not the only one that has been developed for this language. Moreover, it has been the case that during the development of several wordnets for other languages significant changes and/or additions were made to the underlying structure and content of the English section of the wordnet. In at least one case, namely the development of the Polish wordnet, plWordNet, the additions to the underlying English wordnet have been so numerous that they were released as a new wordnet, enWordnet (Rudnicka et al., 2015; Maziarz et al., 2016). These involved the addition of new lemmas (over 11k), lexical units (over 11k) and synsets (7.5k). The latter were linked to WordNet 3.1 synsets via hyponymy relation. Still, no alterations to the original WordNet synsets or relations were made within this project. Currently, enWordnet is only available as part of the plWordNet project and does not constitute a ‘drop-in’ replacement for Princeton WordNet.

Some projects have attempted to expand Prince-

ton WordNet with new terminology in other directions, for example the Colloquial WordNet project (McCrae et al., 2017), has been working on adding new terms that are used in social media, and this is available using the same GWC formats (McCrae et al., 2019) as this work; a similar project called SlangNet (Dhuliawala et al., 2016) seems to be unavailable now. There have also been a number of attempts to extend WordNet in terms of the kinds of annotation that it contains, such as the addition of sentiment and emotion information (Strapparava et al., 2004) or combining it with a upper-level ontology (Niles and Pease, 2003).

Another significant direction has been the automatic extension of WordNet and several projects have been published based on extending WordNet with information from other resources, especially Wiktionary and Wikipedia. One of the most prominent of such resources is BabelNet (Navigli and Ponzetto, 2012), which combines multiple methods using machine learning based methods, which have been shown to have a precision of up to 89.7%. A similar effort was carried out by the UKP group and led to the Uby resource (Gurevych et al., 2012), who report similar levels of accuracy in the mapping. While such automatically constructed resources may be valuable for a large number of applications, they cannot replace WordNet for applications that require a gold standard lexicon or very high precision. Further, many of these resources have taken WordNet as is, and have often repeated the same design and frequently copied many of the minor errors into their own resources.

3 The Open English WordNet Project

The Open English WordNet Project² takes the form of a single Git repository, published on GitHub, and consisting for the most part of a collection of XML files describing the synsets and lexical entries in the resource. These XML files represent each of the lexicographer file sections of the original resource and a simple script is provided to stitch them together into a single XML file. The XML files are compliant with the GWC LMF model (McCrae et al., 2019)³, which is itself based partially on the LMF model (Francopoulo et al., 2006) and in particular the WordNet (a.k.a

²<https://github.com/globalwordnet/english-wordnet>

³<https://globalwordnet.github.io/schemas/>

Kyoto) LMF variant (Soria et al., 2009). Due to its basis on LMF, a particular challenge was that the entire wordnet should be represented as a single XML document. However, due to the relative verbosity of the LMF format, the final data ended up as 97 MB, exceeding the upload limits of GitHub, so instead the single XML file was divided by lexicographer sections. Even still, this creates several very large files (over 10 MB) and this has resulted in some challenges for those working on the project⁴, which may be solved by the adoption of a less verbose format.

The model for contributing to this work is similar to that of other large open-source projects, where a small number of trusted developers are able to make changes to the code directly to the source of the wordnet, while submissions may be proposed by any user registered with GitHub in two principal channels:

Issues Any user may log an issue with the system, describing the changes that they would like to make to the wordnet, along with technical information including the identifier of the synset and the type of proposed change (e.g., ‘merge synset’). Issues are then assigned to a trusted developer and implemented by them.

Pull request Technically-inclined users may make the changes directly to the XML and propose them for review by one of the trusted developers. This method generally leads to faster acceptance of changes.

In both cases, changes are covered by contribution guidelines⁵, which also maintain the integrity of the project in terms of fostering an inclusive, kind, harassment-free, and cooperative community. Currently, this combination of technical hurdles and clear guidelines has prevented any cases of politically motivated or otherwise inappropriate changes being proposed to the wordnet.

In addition to the raw data itself, a number of scripts have been introduced that can be used with the model. These include a ‘post-receive’ hook that takes the most recent changes to the WordNet and immediately converts it into other formats including RDF based on OntoLex-Lemon (Cimiano

⁴Issue #31: <https://github.com/globalwordnet/english-wordnet/issues/31>

⁵<https://github.com/globalwordnet/english-wordnet/blob/master/CONTRIBUTING.md>

et al., 2014) as well as in the WNDB formats used for previous versions of WordNet, allowing English WordNet to be a ‘drop-in’ replacement for Princeton WordNet. Furthermore, this update is used to populate the searchable frontend, which is available at <http://en-word.net/>.

4 Scope of Changes

One of the first major class of errors that we attempted to fix were simple spelling errors that occur particularly in the definitions and the examples of the synsets. In most cases these were entirely obvious errors for example the following definition:

habitually do something or be in a certain⁶ state or place (use only in the past tense)

This change in a few cases also affected the lemmas in the resource, for example the lemma ‘poetic justice’ was corrected. In a few cases, there was uncertainty as the spelling variant was non-standard, for example in 3 cases the word ‘Moslem’ was used as opposed to the 115 cases of the far more common variant ‘Muslim’, so these were corrected to a single spelling form.

A second major source of errors was that many examples did not use any lemmas from the synset and as such could not be considered examples of the synset. We used a simple edit distance based approach to identify 434 synsets for which this appeared to be an issue. Of those we found that 341 represented a clear error that was easy to be fixed. For these various strategies were followed:

- The example was deleted as there were other examples in the synset that exemplified the meaning better
- A new example was found by conducting a GDEX (Kilgarriff et al., 2008) search of a EnTenTen15 web corpus provided by the Sketch Engine tool⁷.
- The example was modified by replacing a word not in the synset with a synset member or by providing a suitable modification, for example the example of ‘double negative’ was ‘I don’t never go’ and was updated to ‘double negative such as ‘I don’t never go’ to include the lemma.

⁶corrected to ‘certain’

⁷<https://www.sketchengine.eu/>

- An issue was logged, as it was identified that this example shows a more significant change. This was often the case when the example used a lemma or a hypernym and it was not clear if the distinction between synsets was meaningful.

A third major change was to introduce new synset members based on a previously calculated WordNet-Wikipedia mapping (McCrae, 2018). In particular, if this mapping, which has already been manually verified, linked to a page title that did not match the lemma, the page title was added as a new lemma to the synset. This was, as with all changes, manually verified in its entirety before the change was made.

Finally, the repository has been open to new suggestions of changes and there have been many suggestions already contributed about sporadic and various changes to the wordnet. A sample of these include:

- The sense of ‘threepenny’ as a size was incorrect in the actual length in inches of a threepenny.
- Grammatical errors were fixed, such as in the definition ‘(of) or pertaining to the Corinthian style of architecture’ of ‘Corinthian’ the first word was missing.
- The death dates and birth dates of various famous figures. Notably the change to the synset for ‘William A. Cragie’ was accepted into the Princeton WordNet and is the only change from this project that has been taken up to date.

5 Ambition

Our ambition for this project is to have annual releases and as such we detail some of the changes that we plan to make that would not fundamentally change the nature of the resource, and these changes will likely be the basis of the releases for the next couple of years. We then look into more significant extensions that would be planned for releases in the long-term.

5.1 Non-trivial fixes

Currently, there are 113 open issues listed on the project and this is due to a clear plan that the project would only deal with issues for the 2019 release that are unlikely to have any effect on any

Change Type	Issues Reported
Synset Duplicate	45
Synset Split	7
New Synset	22
Synset Members	10
Delete Synset	8
Add Relation	3
Change Relation	14
Definition	18
Example	1

Table 1: The current list of issues that have been reported but not implemented in this version of the resource

projects that are dependent on Princeton WordNet. This precludes making certain changes involving deleting or adding new synsets, however this restriction is intended to be relaxed for the 2020 release. A summary of the kinds of errors is given in Table 1, and these are categorized by the likely changes that would need to be made.

Synset duplicate It appears that two synsets refer to the same concept. For example, currently the wordnet has entries for both ‘Aram Kachaturian’ and ‘Aram Khachaturian’⁸, in both cases referring to an Armenian composer with the same date of birth. In this case one of the synsets will be deleted and all synset links merged.

Synset split In some cases it has been suggested that a synset represents two distinct concepts. For example, the synset for ‘Dharma’⁹ is defined as ‘basic principles of the cosmos; also: an ancient sage in Hindu mythology worshipped as a god by some lower castes’, and it is clear that these two definitions are not compatible. These cases are harder to solve, as it is unclear whether a single new concept should be introduced or whether the original should be deleted and two new concepts introduced.

New synset Here obvious gaps have been discovered in WordNet. For example, the synset for ‘jackal’ also identifies the synset by its

⁸<https://github.com/globalwordnet/english-wordnet/issues/66>

⁹<https://github.com/globalwordnet/english-wordnet/issues/113>

	Princeton WordNet 3.1	English WordNet 2019 (Change)
Synsets	117,791	117,791
Lemma	159,015	159,789 (+797, -23)
Senses	207,272	208,353 (+1,081)
Synset Relations	285,668	285,666 (-2, 662 changed)
Sense Relations	92,535	92,535
Definitions	117,791	117,791 (925 changed)
Examples	47,539	48,419 (-237, +1117)

Table 2: Comparative size of Princeton WordNet 3.1 and English WordNet 2019

Latin name ‘Canis aureus’¹⁰. However, in fact ‘jackal’ is a term for four closely related Canis species, suggesting that all four should have synsets with a single upper concept for all jackals.

Synset members In this case, one of the synset members is incorrect and could be updated. This is often reported alongside a second issue above (synset split).

Delete synset In general, we would prefer not to remove synsets from the WordNet, however there are several synsets in Princeton WordNet that do not seem to meet the requirements for inclusion. An example of this is ‘de-ionate’, which while clear in its meaning, does not, according to searches of Sketch Engine’s large EnTenTen15 Web Corpus, appear to be in use in any domain. There is still an open question as to whether we should delete such rare or incorrect words, however we do notice that on a Google search for this term, the few usages we can find appear to be cases where ‘deionized’ was likely intended, and so omitting incorrect words may help users to identify errors in their usage of the language.

Add relation This indicates a relation between two synsets is missing.

Change relation The type or target of a relation is incorrect. A number of clearer errors of this type were fixed in the 2019 release (e.g., the use of `hypernym` in place of `instance_hypernym`) and others are scheduled for 2020, for example the inclusion of ‘impressionist’ as a direct hyponym

of ‘painter’ suggesting that impressionist art was only carried out through the medium of painting.

Definition/example These represent the largest class of changes in the 2019 release as they only affected issues with the textual definition of synsets and most of these could be implemented without any semantic change to the synset. More of these changes are planned for the 2020 version of English WordNet.

5.2 Extending WordNet

As described in the introduction, there are a number of resources that have made extensions to WordNet and there seems to be no strong reason that the results of these projects could not be included within the English WordNet. Firstly, the Colloquial WordNet project (McCrae et al., 2017) uses the same form of data as English WordNet and many of its entries could be easily included in the context of English WordNet. However, as the resource was mostly created by a single annotator the quality control issues are not clear. Furthermore, by the nature of the resource, it follows that some of the entries may be too vulgar or ephemeral to be worthy of inclusion in English WordNet, however these are marked in the original resource.

Another large resource with many extra English synsets is enWordNet (Maziarz et al., 2016) and this consists of many extensions to WordNet, which could be introduced into English WordNet. Although the format used for enWordNet is different to that of English WordNet (and in fact conceptually differs in some ways from that of Princeton WordNet), many of the definitions introduced appear to be drawn from Wikipedia and this may require the project to adopt the more restrictive CC-BY-SA license of Wikipedia. Moreover, it is not

¹⁰<https://github.com/globalwordnet/english-wordnet/issues/125>



Figure 1: Screenshot of the new English WordNet interface

clear how many of the entries have been reviewed by native speakers of English.

Finally, a long term goal would be to introduce a principled method for introducing new synsets, which are of high quality and this would have to involve reviewing of all the links between synsets that have been introduced. It is expected that this could be achieved by a semi-automatic procedure where potential links are learnt from text (Espinosa-Anke et al., 2016) combined with a crowd-sourced reviews. Another important aspect of each synset is also its definition and as many of the definitions in WordNet are of poor quality (McCrae and Prangnawarat, 2016), it is necessary to adopt some general guidelines for writing definitions that can ensure high quality, such as those defined for ontological definitions (Seppälä et al., 2017). Further, we will implement and further extend the validations that are available and automate the checking such that it is clear if any changes are breaking issues. In particular, we currently implement simple DTD validation of the merged XML, which also catches many other issues, such as senses without synsets, but we are working to extend this validation to include issues, such as hypernyms without hyponyms, etc.

In order to achieve this, it is important that strong tools are available for the creation and maintenance of the resource and it is likely that tools coming out of the ELEXIS project (Krek

et al., 2018; Pedersen et al., 2018) will be adapted to this task.

6 Results for this release

This release represents a mostly maintenance release where obvious errors have been fixed. In Table 2 we see that most of the updates are to the definitions and examples used to describe the synsets in English WordNet. There have also been a number of removals relative to the previous version of Princeton WordNet: misspelled lemmas were removed and replaced with a correctly spelled variant and these were counted as both a removal and addition of a lemma. Secondly, due to an issue¹¹ two links were removed as they were deemed clearly incorrect. These changes in total 2,002 synsets which means changes in 1.70% of synsets over the most recent version of Princeton WordNet.

7 Interface to English WordNet

In addition to the development of a new resource, we have also developed a new interface to the resource, which is available at <https://en-word.net>. This interface is developed using the latest Web technologies including the

¹¹<https://github.com/globalwordnet/english-wordnet/issues/11>

use of AngularJS¹² and the use of Rocket¹³, a Rust-based framework for Web applications. This interface is also open-source and released on GitHub¹⁴. This interface provides a fast and attractive interface (see Figure 1) to the data and in addition, allows the data to be browsed as linked data using the RDF interface as provided by (McCrae et al., 2014). In addition, clear links are provided to the GitHub to encourage contributions and to the Global WordNet Association.

8 Conclusion

In this paper, we have presented a new version of WordNet for English that has been developed as a fork of the Princeton Wordnet and in particular we describe the first release of this resource as a ‘drop-in’ replacement for the Princeton WordNet. As a main contribution, we have moved the development of English WordNet to an open-source framework, ensuring that the development of WordNet is not constrained by the funding situation at a single institute. Instead, we commit to a yearly update cycle and welcome contributions from many directions. We believe that one of the most important challenges with this will be ensuring that WordNet can remain a gold standard resource for NLP applications. Moreover, we note that as this resource has fixed over 3,500 errors in WordNet, the English WordNet 2019 release is naturally of higher quality than any previous Princeton WordNet release.

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¹²<https://angularjs.org/>

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