

# calamanCy: A Tagalog Natural Language Processing Toolkit

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## Abstract

We introduce calamanCy, an open-source toolkit for constructing natural language processing (NLP) pipelines for Tagalog. It is built on top of spaCy, enabling easy experimentation and integration with other frameworks. calamanCy addresses the development gap by providing a consistent API for building NLP applications and offering efficient multitask models with out-of-the-box support for dependency parsing, part-of-speech (POS) tagging, and named entity recognition (NER). calamanCy aims to accelerate the progress of Tagalog NLP by consolidating disjointed resources in a unified framework. The calamanCy toolkit can be found on Github: <https://github.com/ljvmiranda921/calamanCy>.

## 1 Introduction

Tagalog is a low-resource language from the Austronesian family with over 76 million speakers in the Philippines (Lewis, 2009). Despite its speaker population, few resources exist for the language (Cruz and Cheng, 2021). For example, Universal Dependencies (UD) treebanks for Tagalog are tiny ( $\ll$  20k words) (Samson, 2018; Aquino and de Leon, 2020), while domain-specific corpora are sparse (?). In addition, Tagalog language models (LMs) (Cruz and Cheng, 2021; Jiang et al., 2021) are few while most multilingual LMs (Conneau et al., 2019; Devlin et al., 2019) underrepresent the language. Thus, consolidating these disjointed resources in a coherent framework is still an open problem. The lack of such framework hampers model development, experimental workflows, and the overall advancement of Tagalog NLP.

To address this problem, we introduce calamanCy,<sup>1</sup> an open-source toolkit for Tagalog NLP. It is built on top of spaCy (Honnibal et al., 2020) and offers end-to-end pipelines for NLP tasks such

as dependency parsing, parts-of-speech (POS) tagging, and named entity recognition (NER). calamanCy also provides models of different sizes to fit any performance or accuracy requirements. This work has two main contributions: (1) an open-source toolkit containing multitask pipelines with out-of-the box support for common NLP tasks, and (2) structured benchmarks that evaluate on several Tagalog core NLP tasks.

## 2 Related Work

**Open-source toolkits for NLP** There has been a growing body of work in the development of NLP toolkits in recent years. For languages, these toolkits include DaCy for Danish (Enevoldsen et al., 2021) and HuSpaCy for Hungarian (Orosz et al., 2022). For domain-specific data, there is medspaCy for clinical text (Eyre et al., 2021) and scispaCy for scientific documents (Neumann et al., 2019). These tools employ spaCy (Honnibal et al., 2020), an industrial-strength open-source software for natural language processing. Using spaCy as a foundation is an optimal choice given its popularity and tight integration with other frameworks such as HuggingFace (Wolf et al., 2019). However, no tool exists for Tagalog until now. In this paper, we will showcase how calamanCy provides similar capabilities to DaCy and HuSpaCy using Tagalog resources.

**Evaluations on Tagalog NLP Tasks** Structured evaluations for core NLP tasks, such as dependency parsing, POS tagging, and NER, are sparse. However, we have access to a reasonable amount of data to conduct comprehensive benchmarks. For example, TLUnified (Cruz and Cheng, 2021) is a pretraining corpus that combines news reports (Cruz et al., 2020), a preprocessed version of CommonCrawl (Suarez et al., 2019), and several other datasets. However, it was evaluated on domain-specific applications that may not easily transfer

<sup>1</sup>The name “calamanCy” came from *kalamansi*, a citrus fruit native to the Philippines.

Entity	Description	Examples
Person (PER)	Person entities limited to humans. It may be a single individual or group.	Juan de la Cruz, Jose Rizal, Quijano de Manila
Organization (ORG)	Organization entities limited to corporations, agencies, and other groups of people defined by an organizational structure.	Meralco, DPWH, United Nations
Location (LOC)	Location entities are geographical regions, areas, and landmasses. Geo-political entities are also included within this group.	Pilipinas, Manila, CAL-ABARZON, Ilog Pasig

Table 1: Entity types used for annotating calamanCy-gold (derived from the TLUnified corpus of Cruz and Cheng, 2021). Annotation guidelines can be found at [https://github.com/ljvmiranda921/calamanCy/tree/master/datasets/tl\\_calamancy\\_gold\\_corpus/guidelines](https://github.com/ljvmiranda921/calamanCy/tree/master/datasets/tl_calamancy_gold_corpus/guidelines)

to more general tasks. For dependency parsing and POS tagging, we have Universal Dependencies treebanks such as TRG (Samson, 2018) and Ugnayan (Aquino and de Leon, 2020). This paper will fill the evaluation gap by providing structured benchmarks on these core tasks.

### 3 Implementation

The best way to use calamanCy is through its trained pipelines. After installing the library, users can access the models via:

```
import calamancy as cl
nlp = cl.load("tl_calamancy_md-0.1.0")
```

Here, the variable `nlp` is a spaCy processing pipeline.<sup>2</sup> It contains trained components for POS tagging, dependency parsing, and NER. calamanCy offers three pipelines of varying capacity: two static word vector-based models (`md`, `lg`), and one transformer-based model (`trf`). We will discuss how these pipelines were developed in the following section.

#### 3.1 Pipeline development

**Data annotation** To construct the NER corpus, we curated a portion of TLUnified (Cruz and Cheng, 2021) to only contain Tagalog news articles. Including the author, we recruited two more annotators who have at least a Bachelors degree and whose native language is Tagalog. The three annotators labeled over the course of four months given three entity types as seen in Table 1. The entity types were chosen to resemble ConLL (Sang, 2002; Sang and Meulder, 2003), a standard NER benchmark. We measured inter-annotator agree-

Dataset	Examples	PER	ORG	LOC
Training	6252	6418	3121	3296
Development	782	793	392	409
Test	782	818	423	438

Table 2: Dataset statistics for calamanCy-gold.

ment (IAA) by taking the pairwise Cohen’s  $\kappa$  without the un-annotated tokens then averaged them for all three pairs. This process resulted to a Cohen’s  $\kappa$  score of 0.78. To avoid confusing with the original TLUnified corpora, we will refer to this annotated NER dataset as calamanCy-gold. The final dataset statistics can be found in Table 2. For the dependency parser and POS tagger, we merged the TRG (Samson, 2018) and Ugnayan (Aquino and de Leon, 2020) treebanks to leverage their small yet relevant examples.

**Model training** We considered three design dimensions when training the calamanCy pipelines: (1) presence of pretraining, (2) the word representation, and (3) the representation or dimension size. *Pretraining* involves learning vectors from raw text to better inform model initialization. This process is done using a variant of the cloze task (Devlin et al., 2019). Here, the pretraining objective asks the model to predict some number of leading and trailing UTF-8 bytes for the words. *Word representations* may either involve training static word embeddings using floret,<sup>3</sup> an efficient version of fastText (Bojanowski et al., 2016), or using context-sensitive vectors from a transformer (Vaswani et al., 2017). Finally, the *dimension* is determined via a performance-accuracy tradeoff.

<sup>2</sup><https://spacy.io/usage/processing-pipelines>

<sup>3</sup><https://github.com/explosion/floret>

Pipeline	Pretraining objective	Word embeddings	Dimensions
Medium-sized pipeline ( <code>tl_calamancy_md</code> )	Predict some number of leading and trailing UTF-8 bytes for the words.	Uses floret vectors trained on the TLUnified corpora.	50k unique vectors (200 dimensions), Size: 77 MB
Large-sized pipeline ( <code>tl_calamancy_lg</code> )	Same pretraining objective as the medium-sized pipeline.	Uses fastText vectors trained on Common-Crawl corpora.	714k unique vectors (300 dimensions), Size: 455 MB
Transformer-based pipeline ( <code>tl_calamancy_trf</code> )	No separate pretraining because there’s no token-to-vector component.	Context-sensitive vectors from a transformer network.	Uses roberta-tagalog-base. Size: 813 MB

Table 3: Language pipelines available in calamanCy (v0.1.0). The pretraining method for the word-vector models is a variant of the *cloze task*. All pipelines have a tagger, parser, morphologizer, and ner spaCy component.

Dataset	Task / Labels	Description
Hatespeech (Cabasag et al., 2019)	Binary text classification ( <i>hate speech, not hate speech</i> )	Contains 10k tweets collected during the 2016 Philippine Presidential Elections labeled as hate speech or non-hate speech.
Dengue (Livelo and Cheng, 2018)	Multilabel text classification ( <i>absent, dengue, health, sick, mosquito</i> )	Contains 4k dengue-related tweets collected for a health infoveillance application that classifies text into dengue subtopics.
calamanCy-gold (Held-out test split)	Named entity recognition ( <i>Person, Organization, Location</i> )	A held-out test split from the calamanCy gold corpora (based from Cruz and Cheng, 2021’s TLUnified) containing news reports.
Merged UD	Dependency parsing	Merged version of the Ugnayan and TRG treebanks (Aquino and de Leon, 2020; Samson, 2018).

Table 4: Datasets for calamanCy benchmarking. We evaluated the *Hatespeech*, *Dengue*, and *calamanCy-gold (Test)* datasets for five trials, and then conducted 10-fold cross-validation for the *Merged UD* treebank.

The general process involves pretraining a filtered version of TLUnified, constructing static word embeddings if necessary, and training the downstream components. We trained the NER component using data from calamanCy-gold, while the dependency parser and POS tagger were trained using the combined TRG and Ugnayan treebanks. In the end, we came up with three language pipelines of varying sizes as seen in Table 3.<sup>4</sup>

## 4 Evaluation

**Tasks and benchmark datasets** We evaluated the calamanCy pipelines on various Tagalog benchmarks as seen in Table 4. Unlike the *Hatespeech* and *Dengue* text categorization datasets, there is

no reasonably-sized benchmark for NER and dependency parsing. So instead, we used a held-out test split from calamanCy-gold (*calamanCy-gold, Test*) for the former and then merged the two UD treebanks (*Merged UD*) for the latter. However, the combined UD treebank is still small ( $\ll 20k$  words), so we evaluated it using 10-fold cross-validation. Finally, we evaluated all the other datasets for five trials and then reported their average and standard deviation.

## Architectures

## 5 Discussions

## 6 Conclusion

## References

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<sup>4</sup>The naming convention resembles spaCy’s model names: {language code}\_{source}\_{size}. The full training configuration for the 0.1.0 version can be found on Github: <https://github.com/ljvimrainda921/calamanCy/tree/master/models/v0.1.0>

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