

# Evaluation of Named Entity Recognition in Latin using an Unsupervised Model

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## Abstract

Tackling the challenges of Natural Language Processing (NLP) in Latin using an unsupervised model has lead to the conclusion that certain tokenizers such as BERT are better suited for such tasks and that the choice of the model itself plays a significant role in the final results. Clustering has proved to be the most straightforward method to group entities together but the hyperparameter tuning lead to fascinating observations.

## 1 Clustering

Notes

## 2 NN

Notes

## 3 Introduction

Original Paper: <sup>1</sup> Bert split words embedding not great, no benefit Combining back to words is good since we cluster on word level

## 4 Engines

To produce a PDF file, pdfL<sup>A</sup>T<sub>E</sub>X is strongly recommended (over original L<sup>A</sup>T<sub>E</sub>X plus dvips+ps2pdf or dvi2pdf). The style file acl.sty can also be used with luaL<sup>A</sup>T<sub>E</sub>X and XeL<sup>A</sup>T<sub>E</sub>X, which are especially suitable for text in non-Latin scripts. The file acl\_lualatex.tex in this repository provides an example of how to use acl.sty with either luaL<sup>A</sup>T<sub>E</sub>X or XeL<sup>A</sup>T<sub>E</sub>X.

## 5 Preamble

The first line of the file must be

```
\documentclass[11pt]{article}
```

To load the style file in the review version:

<sup>1</sup><http://acl-org.github.io/ACLPUb/formatting.html>

```
\usepackage[review]{acl}
```

For the final version, omit the review option:

```
\usepackage{acl}
```

To use Times Roman, put the following in the preamble:

```
\usepackage{times}
```

(Alternatives like txfonts or newtx are also acceptable.)

Please see the L<sup>A</sup>T<sub>E</sub>X source of this document for comments on other packages that may be useful.

Set the title and author using \title and \author. Within the author list, format multiple authors using \and and \And and \AND; please see the L<sup>A</sup>T<sub>E</sub>X source for examples.

By default, the box containing the title and author names is set to the minimum of 5 cm. If you need more space, include the following in the preamble:

```
\setlength\titlebox{<dim>}
```

where <dim> is replaced with a length. Do not set this length smaller than 5 cm.

## 6 Document Body

### 6.1 Footnotes

Footnotes are inserted with the \footnote command.<sup>2</sup>

### 6.2 Tables and figures

See Table 1 for an example of a table and its caption. **Do not override the default caption sizes.**

As much as possible, fonts in figures should conform to the document fonts. See Figure 1 for an example of a figure and its caption.

Using the graphicx package graphics files can be included within figure environment at

<sup>2</sup>This is a footnote.

Command	Output	Command	Output
<code>\`a</code>	ä	<code>\c c</code>	ç
<code>\^e</code>	ê	<code>\u g</code>	ğ
<code>\`i</code>	ì	<code>\l</code>	ł
<code>\.I</code>	İ	<code>\~n</code>	ñ
<code>\o</code>	ø	<code>\H o</code>	õ
<code>\'u</code>	ú	<code>\v r</code>	ř
<code>\aa</code>	å	<code>\ss</code>	ß

Table 1: Example commands for accented characters, to be used in, *e.g.*, BibT<sub>E</sub>X entries.



Figure 1: A figure with a caption that runs for more than one line. Example image is usually available through the mwe package without even mentioning it in the preamble.

an appropriate point within the text. The graphicx package supports various optional arguments to control the appearance of the figure. You must include it explicitly in the L<sup>A</sup>T<sub>E</sub>X preamble (after the `\documentclass` declaration and before `\begin{document}`) using `\usepackage{graphicx}`.

### 6.3 Hyperlinks

Users of older versions of L<sup>A</sup>T<sub>E</sub>X may encounter the following error during compilation:

```
\pdfendlink ended up in different nest-
ing level than \pdfstartlink.
```

This happens when pdfL<sup>A</sup>T<sub>E</sub>X is used and a citation splits across a page boundary. The best way to fix this is to upgrade L<sup>A</sup>T<sub>E</sub>X to 2018-12-01 or later.

### 6.4 Citations

Table 2 shows the syntax supported by the style files. We encourage you to use the natbib styles. You can use the command `\citet` (cite in text) to get “author (year)” citations, like this citation to a paper by Gusfield (1997). You can use the command `\citep` (cite in parentheses) to get “(author, year)” citations (Gusfield, 1997). You can use

the command `\citealp` (alternative cite without parentheses) to get “author, year” citations, which is useful for using citations within parentheses (*e.g.* Gusfield, 1997).

A possessive citation can be made with the command `\citepos`. This is not a standard natbib command, so it is generally not compatible with other style files.

### 6.5 References

The L<sup>A</sup>T<sub>E</sub>X and BibT<sub>E</sub>X style files provided roughly follow the American Psychological Association format. If your own bib file is named `custom.bib`, then placing the following before any appendices in your L<sup>A</sup>T<sub>E</sub>X file will generate the references section for you:

```
\bibliography{custom}
```

You can obtain the complete ACL Anthology as a BibT<sub>E</sub>X file from <https://aclweb.org/anthology/anthology.bib.gz>. To include both the Anthology and your own .bib file, use the following instead of the above.

```
\bibliography{anthology,custom}
```

Please see Section 7 for information on preparing BibT<sub>E</sub>X files.

### 6.6 Equations

An example equation is shown below:

$$A = \pi r^2 \tag{1}$$

Labels for equation numbers, sections, subsections, figures and tables are all defined with the `\label{label}` command and cross references to them are made with the `\ref{label}` command.

This an example cross-reference to Equation 1.

### 6.7 Appendices

Use `\appendix` before any appendix section to switch the section numbering over to letters. See Appendix A for an example.

## 7 BibT<sub>E</sub>X Files

Unicode cannot be used in BibT<sub>E</sub>X entries, and some ways of typing special characters can disrupt BibT<sub>E</sub>X’s alphabetization. The recommended way of typing special characters is shown in Table 1.

Please ensure that BibT<sub>E</sub>X records contain DOIs or URLs when possible, and for all the ACL materials that you reference. Use the `doi` field for

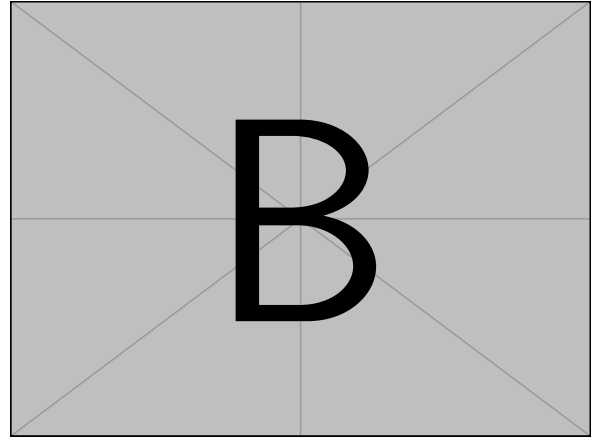
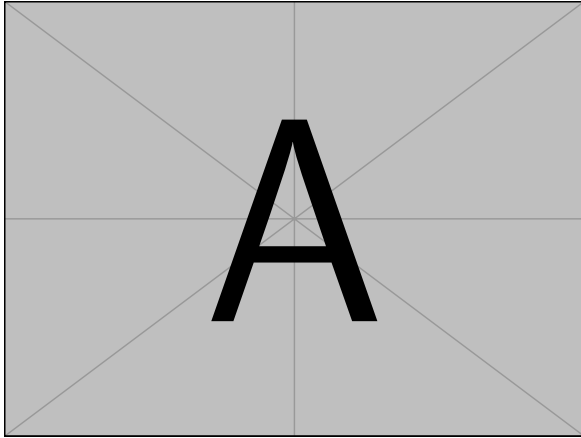


Figure 2: A minimal working example to demonstrate how to place two images side-by-side.

Output	natbib command	ACL only command
(Gusfield, 1997)	<code>\citep</code>	
Gusfield, 1997	<code>\citealp</code>	
Gusfield (1997)	<code>\citet</code>	
(1997)	<code>\citeyearpar</code>	
Gusfield’s (1997)		<code>\citeposs</code>

Table 2: Citation commands supported by the style file. The style is based on the natbib package and supports all natbib citation commands. It also supports commands defined in previous ACL style files for compatibility.

DOIs and the `url` field for URLs. If a Bib<sub>T</sub><sub>E</sub>X entry has a URL or DOI field, the paper title in the references section will appear as a hyperlink to the paper, using the `hyperref` L<sub>A</sub>T<sub>E</sub>X package.

## Limitations

Since December 2023, a "Limitations" section has been required for all papers submitted to ACL Rolling Review (ARR). This section should be placed at the end of the paper, before the references. The "Limitations" section (along with, optionally, a section for ethical considerations) may be up to one page and will not count toward the final page limit. Note that these files may be used by venues that do not rely on ARR so it is recommended to verify the requirement of a "Limitations" section and other criteria with the venue in question.

## Acknowledgments

This document has been adapted by Steven Bethard, Ryan Cotterell and Rui Yan from the instructions for earlier ACL and NAACL proceedings, including those for ACL 2019 by Douwe Kiela and Ivan Vulić, NAACL 2019 by Stephanie Lukin and Alla Roskovskaya, ACL 2018 by Shay Cohen, Kevin Gimpel, and Wei Lu, NAACL 2018 by Margaret Mitchell and Stephanie Lukin, Bib<sub>T</sub><sub>E</sub>X suggestions

for (NA)ACL 2017/2018 from Jason Eisner, ACL 2017 by Dan Gildea and Min-Yen Kan, NAACL 2017 by Margaret Mitchell, ACL 2012 by Maggie Li and Michael White, ACL 2010 by Jing-Shin Chang and Philipp Koehn, ACL 2008 by Johanna D. Moore, Simone Teufel, James Allan, and Sadaoki Furui, ACL 2005 by Hwee Tou Ng and Kemal Oflazer, ACL 2002 by Eugene Charniak and Dekang Lin, and earlier ACL and EACL formats written by several people, including John Chen, Henry S. Thompson and Donald Walker. Additional elements were taken from the formatting instructions of the *International Joint Conference on Artificial Intelligence* and the *Conference on Computer Vision and Pattern Recognition*.

## References

- Rie Kubota Ando and Tong Zhang. 2005. A framework for learning predictive structures from multiple tasks and unlabeled data. *Journal of Machine Learning Research*, 6:1817–1853.
- Galen Andrew and Jianfeng Gao. 2007. Scalable training of L1-regularized log-linear models. In *Proceedings of the 24th International Conference on Machine Learning*, pages 33–40.
- Dan Gusfield. 1997. *Algorithms on Strings, Trees and*

*Sequences*. Cambridge University Press, Cambridge, UK.

Mohammad Sadegh Rasooli and Joel R. Tetreault. 2015. [Yara parser: A fast and accurate dependency parser](#). *Computing Research Repository*, arXiv:1503.06733. Version 2.

## **A Example Appendix**

This is an appendix.