Multilingual Named Entity Recognition with SpaCy and Stanza

A comparison of two NLP tools

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1. Introduction

Investigate runtime, accuracy and differences on **NER**

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Using Spanish and English data

- **Europarl corpus** (parallel, annotated)
- **OpenSubtitles** (largely parallel, unannotated)

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Stanza slower in all instances

SpaCy is slightly less accurate in English, but does an large amount of mistakes on Spanish data

2. Data and Resources

Main source for NER: **“Evaluation Corpus for Named Entity Recognition using Europarl”**

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Europarl corpus:

- consists of transcriptions of European Parliament sessions
- plenty of various detailed sentences
- contain different entities
- 4 entity types: LOC, PER, ORG, MISC
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Movie subtitles from “opensubtitles.org”

- using subtitles from “Back to the Future” and “El Hoyo”
- everyday language is used
- largely parallel
- contain many names and places, also fictional ones
- unannotated

Software:

- Python version 3.11.4
- NLP libraries:
  - SpaCy v3.6
  - Stanza 1.4.0.
- SpaCy language models:
  - en_core_web_md in English
  - es_core_news_md in Spanish

SpaCy and **Stanza** over **NLTK**:

Unable to find on which data the language model is trained on, therefore we can’t prove that the data used in our project wasn’t used for the training.

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Also used the **re-library** for regular expressions.

3. Method (the Code)

- utils.py:
    - contains auxiliary methods
    - load the data
    - perform Named Entity Recognition
    - evaluate the results

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  - load the data
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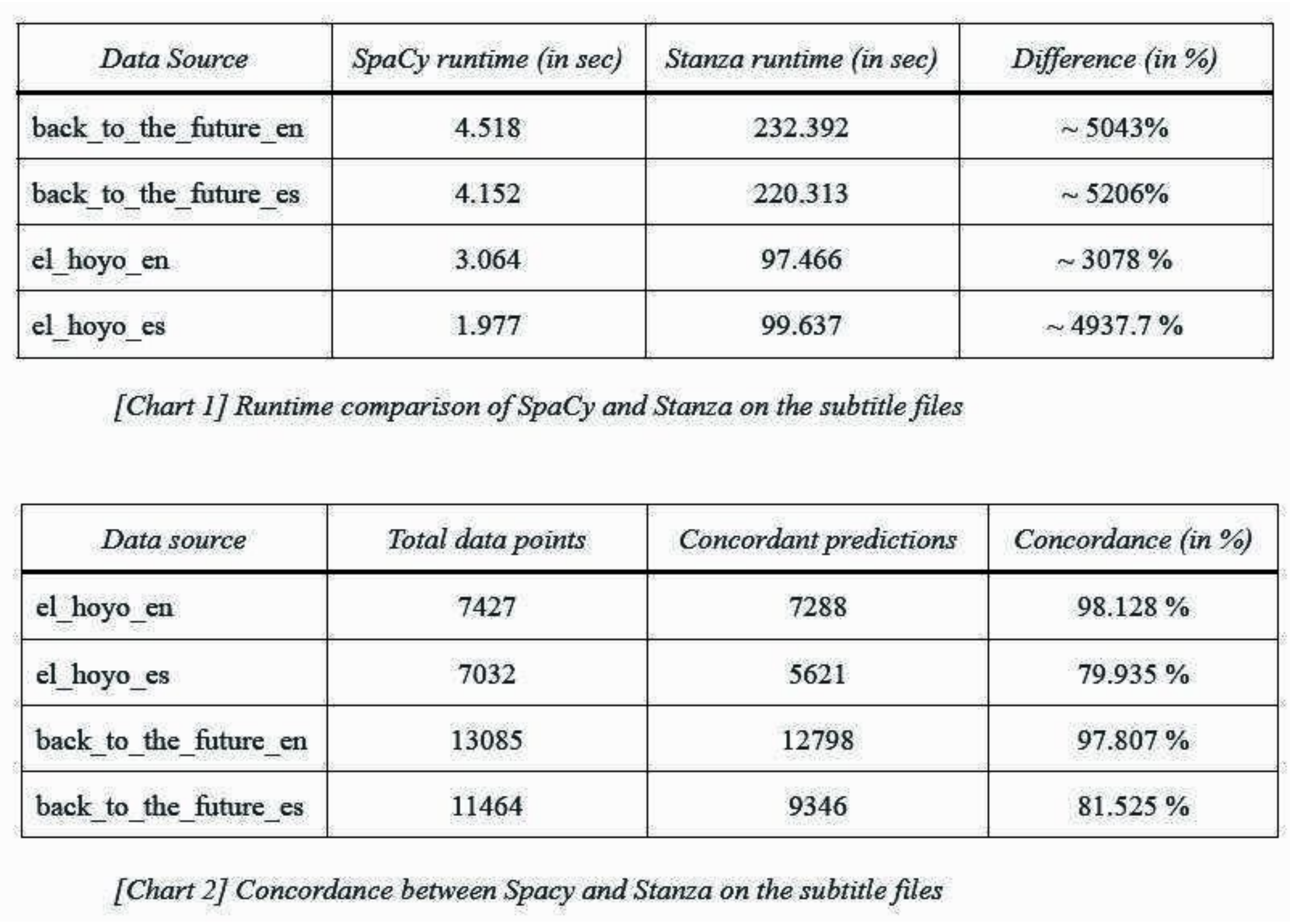
  - evaluate the results
- el_hoyo.py & back_to_the_future.py, europarl_en.py & europarl_es.py:
  - evaluations of the different files executed with the help of methods implemented in utils.py
  - results loaded into text files with respective file names, such as europarl_en_eval.txt

4. Results

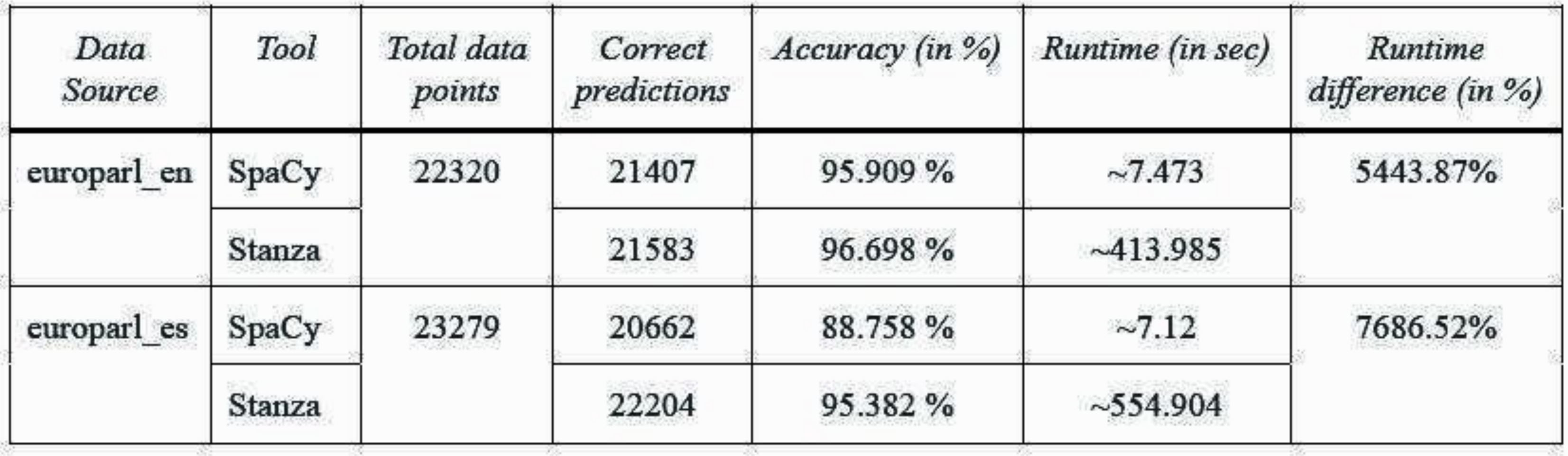


Data Source	*SpaCy runtime (in sec)*	*Stanza runtime (in sec)*	*Difference (in %)*
back_to_the_future_en	4.518	232.392	~ 5043%
back_to_the_future_es	4.152	220.313	~ 5206%
el_hoyo_en	3.064	97.466	~ 3078 %
el_hoyo_es	1.977	99.637	~ 4937.7 %

[Chart 1] Runtime comparison of SpaCy and Stanza on the subtitle files

Data source	*Total data points*	*Concordant predictions*	*Concordance (in %)*
el_hoyo_en	7427	7288	98.128 %
el_hoyo_es	7032	5621	79.935 %
back_to_the_future_en	13085	12798	97.807 %
back_to_the_future_es	11464	9346	81.525 %

[Chart 2] Concordance between Spacy and Stanza on the subtitle files



Data Source	*Tool*	*Total data points*	*Correct predictions*	*Accuracy (in %)*	*Runtime (in sec)*	*Runtime difference (in %)*
europarl_en	SpaCy	22320	21407	95.909 %	~7.473	5443.87%
	Stanza		21583	96.698 %	~413.985	
europarl_es	SpaCy	23279	20662	88.758 %	~7.12	7686.52%
	Stanza		22204	95.382 %	~554.904	

[Chart 3] Accuracy and runtime of SpaCy and Stanza on the Europarl corpus

Europarl - English

- problem with entities specific to context of the European Union, e.g. names of legal texts and organisations
- annotating salutations as PER
- not recognizing several names of persons
- recognizing capitalized words/multi word expressions as ORG

Europarl - Spanish

- Stanza: same errors like in English plus some additional cases
  - Russia labeled as ORG instead of LOC
  - declaring all other country adjectives non-entities (O) instead of MISC

Europarl - Spanish

- Stanza: same errors like in English plus some additional cases
  - Russia labeled as ORG instead of LOC
  - declaring all other country adjectives non-entities (O) instead of MISC
- SpaCy: shares errors and differences with Stanza, seemingly inexplicable mistakes occur as well
  - whole sentences labeled as MISC
  - non-entities recognized as persons

- SpaCy has problems recognizing names of persons: labeling non-entities as PER and some names as O
- both NLP tools struggle recognizing “Doc” (nickname of Doctor Emmett Brown) as PER
- specific names of the fictional characters, events and locations are difficult to recognize for SpaCy
- Stanza isn’t correctly labeling “DeLorean”
- SpaCy: labeling whole sentences in Spanish subtitles as MISC

Source: https://commons.wikimedia.org/wiki/File:Back-to-the-future-logo.svg

DeLorean time machine

Source: https://de.m.wikipedia.org/wiki/Datei:TeamTimeCar.com-BTTF_DeLorean_Time_Machine-OtoGodfrey.com-JMortonPhoto.com-07.jpg

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Source: https://commons.wikimedia.org/wiki/File:Back-to-the-future-logo.svg

- SpaCy
  - labels in Spanish subtitles whole sentences and words that are not entities as MISC, LOC and PER
  - doesn’t recognize names of the main characters Goreng and Trimagashi
- Stanza recognizes sometimes non-entities as PER

- SpaCy labels God and Christ as O, Stanza as PER

Source: https://www.netflix.com/de/title/81128579

5. Challenges and Open Issues

- it was difficult to ensure that both SpaCy and Stanza split the text data in the same way
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- need to “post-process” predictions by SpaCy because of different tag set
- more difficult than anticipated to find parallel annotated corpora for NER
- in future research, the NLTK NLP tool could be included in the comparison

6. Summary and Conclusion

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- English: much shorter runtime of SpaCy outweighs the only slightly improved accuracy of Stanza (less than 1% higher)
- Spanish: SpaCy produces large number of errors compared to Stanza and also many seemingly inexplicable labels
- Stanza offers extensive knowledge of fictional names, applies to both English and Spanish

7. Sources

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Thank you for your attention!