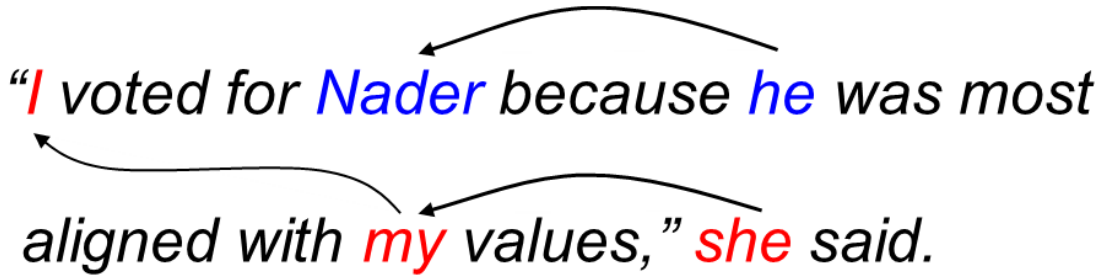
Stanford CoreNLP Coreference Resolution

Coreference resolution: What is it?

Coreference resolution is the process of linking references to the same entity in a document. For example, in this sentence:



(image © https://nlp.stanford.edu/projects/coref.shtml)

The red expressions (I, my, and she) refer to the same entity, and the blue expressions (Nader and he) refer to a different entity. It is necessary to determine which expressions refer to which entities for many different NLP tasks, such as summarization, question answering, and information extraction.

Coreference resolution is art of a general problem known in English grammar as **anaphora**, the use of a pronoun or other linguistic unit to refer back to another word or phrase. A word (a pronoun in the case of coreference pronominal resolution) that gets its meaning from a preceding word or phrase is called an **anaphor**. The preceding word or phrase is called the **antecedent**, **referent, or head**. Anaphora comes from the Greek word meaning "carrying up or back."

And why is it important?

Coreference resolution is an important first step for the accuracy of other NLP tasks. For instance, it is one of the first data cleaning steps involved in the SVO extraction pipeline, in order to have consistent subjects and objects. Without coreference resolution, a frequency distribution of subjects or objects, for instance, may give you a list of "he" "she" "they" that may refer to completely different entities.

Coreference Resolution with Stanford CoreNLP

Stanford CoreNLP offers three different approaches to coreference:

1. Deterministic (fast rule based)
2. Statistical (machine learning requiring dependency parsing)
3. Neural network (most accurate and slowest)

The NLP Suite relies on the neural network approach.

The script replaces all expressions referring to the same entity in a text with one representative expression.

For example, the following sentence:

"Bill Cato attempted to assault Mrs. Vickers, but her husband stopped him."

Would become:

"Bill Cato attempted to assault Mrs. Vickers, but Mrs. Vickers's husband stopped Bill Cato."

Two types of coreference: nominal & pronominal

CoreNLP approaches implement both **pronominal** (i.e., pronouns referring to nouns, e.g., Barack Obama came to Boston; *he* said that…") and **nominal** (i.e., nouns referring to other nouns, e.g., Barack Obama came to Boston; *the President* said that…") coreference resolution. The algorithms do NOT resolve adverbial coreference (i.e., adverbs referring to nouns, e.g., Barack Obama came to Boston; *there* Obama said that…").

The NLP Suite implementation of coreference filters out the nominal coreference and focuses on the **pronominal coreference**. Too many errors otherwise.

Coreference resolution is still far from accurate, with perhaps 65% success.

Four types of pronouns

Pronominal resolution resolves four types of pronouns for the four different cases: nominative, possessive, objective, and reflexive.

The **nominative case** is used when the pronoun is the subject of the sentence. The nominative form pronouns are:

I, you, he/she, it, we, they.

The **possessive case** is used to show ownership or possession of something. The possessive form pronouns are:

My, mine, our(s), his/her(s), their, its, and yours.

The **objective case** is used as the direct object, indirect object, or the object of the preposition. The objective form pronouns are:

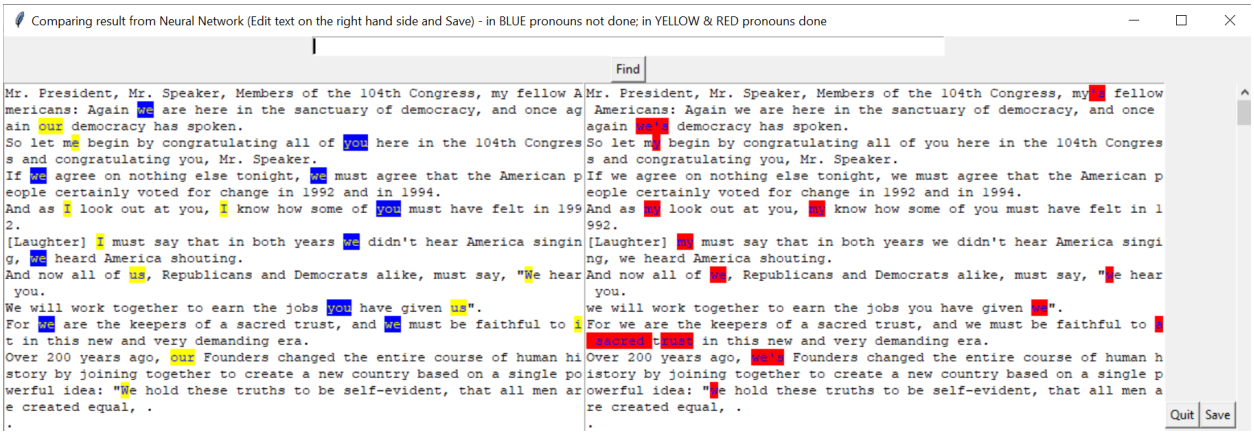
Me, you, him, her, it, and them.

Reflexive pronouns are words ending in -self or -selves that are used when the subject and the object of a sentence are the same (e.g., I believe in myself). They can act as either objects or indirect objects. The reflexive pronouns are:

myself, yourself, himself, herself, oneself, itself, ourselves, yourselves, and themselves.

Manual coreference

Due to the relatively low success rate of coreference resolution, the NLP Suite also implements a manual approach on the coreferenced output, displaying the original and coreferenced documents on two panels, side-by-side, **original on the left** and **coreferenced on the right** with the relevant pronouns and coreferences highlighted.



Yellow, blue, and red: What do these colors mean?

On the **left-hand side**,

pronouns cross-referenced by CoreNLP are tagged in **YELLOW**.

pronouns **NOT** cross-referenced by CoreNLP are tagged in **BLUE**.

On the **right-hand side**,

pronouns cross-referenced by CoreNLP are tagged in **RED**, with the pronouns replaced by the referenced nouns.

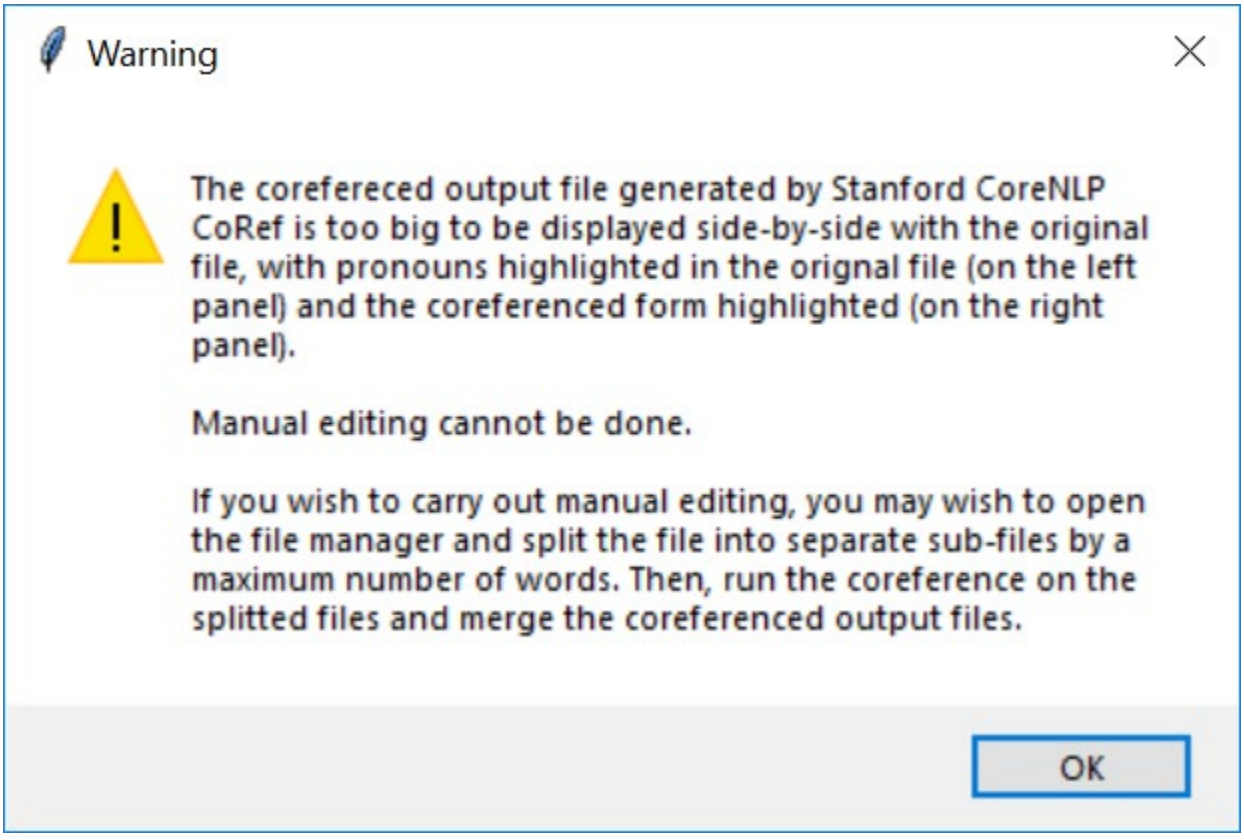
Although the highlighting is not perfect, it does provide the user an immediate visual tool of comparison.

Edit on the right-hand side

The user can edit any unresolved or wrongly resolved pronominal cases directly on the right panel, as if it were any text editor and then save the changes.

Reminders

Since the function works in memory, for large files memory this may not be an option. If that is the case, the script will warn the user.



The script similarly warns the user to deselect manual coreference when processing a directory.

References

Lee, Heeyoung, Angel Chang, Yves Peirsman, Nathanael Chambers, Mihai Surdeanu, and Dan Jurafsky. 2013. "Deterministic coreference resolution based on entity-centric, precision-ranked rules." *Computational Linguistics*, 39(4).

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