Unveiling Strengths and Weaknesses of NLP Systems Based on a Rich Evaluation Corpus: the Case of NER in French

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Abstract

Named Entity Recognition (NER) is an applicative task for which annotation schemes vary. To compare the performance of systems which tagsets differ in precision and coverage, it is necessary to assess (i) the comparability of their annotation schemes and (ii) the individual adequacy of the latter to a common annotation scheme. What is more, and given the lack of robustness of some tools towards textual variation, we cannot expect an evaluation led on an homogeneous corpus with low-coverage to provide a reliable prediction of the actual tools performance. To tackle both these limitations in evaluation, we provide a gold corpus for French covering 6 textual genres and annotated with a rich tagset that enables comparison with multiple annotation schemes. We use the flexibility of this gold corpus to provide both: (i) an individual evaluation of four heterogeneous NER systems on their target tagsets, (ii) a comparison of their performance on a common scheme. This rich evaluation framework enables a fair comparison of NER systems across textual genres and annotation schemes.

Keywords: Named Entity Recognition (NER), Evaluation, Textual variation

1. Introduction

Fair evaluation and comparison of NLP models are essential for developers and users. Eval4NLP[1] workshops, initiated in 2020, emphasized this requires extensive work on both the usage of meaningful and interpretable metrics, and the development of quality and unbiased reference resources. Comparing systems is even more complex when multiple annotation schemes coexist. Named Entity Recognition (NER), on which we chose to focus on this work, is a good example of this difficulty.

NER is a twofold task that comprises (i) a segmentation step and (ii) a classification (labeling) step, both being determined by the annotation scheme. Because NER is an applicative task, annotation schemes vary between systems, hence producing system-specific outcomes.

To compare the performance of various systems, it is necessary to assess (i) the comparability of their annotation schemes and (ii) the adequacies of the latter to a common reference annotation scheme. The application goals of NER tools are diverse in terms of linguistic contexts and use cases. To provide a reliable evaluation, it is thus necessary to confront their performance with (i) interpretable evaluation metrics and (ii) reference corpora that are unbiased in terms of content.

In this paper, we introduce an evaluation framework based on three dimensions: (i) the precision of the tagset, (ii) the textual genres of the evaluation corpora, and (iii) the evaluation metrics. We use this framework to evaluate four NER systems for French, one rule-based and two neural network-based, both independently and plotted against each other. We show that the gold annotation scheme must be seen as a dimension of the evaluation framework to ensure fair and comprehensive comparison between systems.

The contributions of this paper are the following: (i) a reference corpus of 15 samples of 1 000 tokens split between 6 textual genres categories (prose, poetry, speech, encyclopedic, multisource and informative) and manually annotated with a precise hence flexible tagset of 8 types and 23 subtypes, (ii) mappings between the gold tagset, the target tagsets of the evaluated tools, and the minimal tagset at their intersection (iii) a fair evaluation and comparison of French NER systems.

2. Related Work

Multiple metrics have been developed to evaluate NER. Chinchor and Sundheim (1993) introduced five of them to compare gold and obtained outputs at entity level. Those metrics distinguish strictly and partially correct annotations. During the CoNLL-2003 shared task (Tjong Kim Sang and De Meulder, 2003), strict precision, recall and F-score were used. Segura-Bedmar et al. (2013) reused Chinchor and Sundheim (1993) in their evaluation protocol. Tools are evaluated using four types of F-score based on strict or loose matching of types and boundaries. Caubrière et al. (2020) refined the Slot Error Rate variation used in the Quæro shared task (Makhoul et al., 1999; Galibert

[1] See https://eval4nlp.github.io.

et al., 2011) by using hierarchical typing of error, each error type bearing its own weight.
Recent works provide frameworks and comparative studies on evaluation reproductibility. Schmitt et al. (2019) evaluate five NER systems for English (StanfordNLP, NLTK, OpenNLP, SpaCy, Gate) on unseen corpora and show that the results are consistently lower than those found in the literature. Palen-Michel et al. (2021) introduce the SeqScore evaluation framework and compare two systems over 10 African languages with a focus on invalid transitions. Yet, these strict comparisons between systems lead to an evaluation on impoverished annotation schemes that match the smallest common tagset (see also Jiang et al. (2016)).

3. Experimental Setup

3.1. Systems

We chose to evaluate four freely available NER systems for French, which exhibit good performance. The first one, `CasEN` (Friburger and Maurel, 2004), is based on lexical resources, local pattern descriptions and transducers. It was evaluated on the ESLO 1 corpus (Abouda and Baude, 2006) (300 hours of transcribed interviews), and during the ESTER 2 evaluation campaign (Galliano et al., 2009). The second one is the `fr_core_news_lg` model of `SpaCy` (Honnibal and Montani, 2017), based on neural networks, which gives the best results on the French part of *WikiNER* (F1-score of 0.84[2]) among off-the-shelf `SpaCy` models. The third one is the `ner-french` model of `Flair` (Akbik et al., 2018), that uses a bidirectional *Long short-term memory* (*LSTM*) neural network and contextual embeddings (F1-Score of 0.91 on *WikiNER*[3]). At last, we use `CamemBERT-ner`, a camemBERT NER model fine-tuned on the wikiner-fr dataset (F1-score of 0.89[4]). It has to be noted that both neural network based systems were also trained on the French section of *WikiNER*.

The coverage and precision of the annotation schemes vary significantly between `CasEN` (eight types[5]) on the one hand, and `SpaCy`, `Flair` and `CamemBERT-ner` (four types[6]) on the other.

3.2. A New Reference Corpus for French

A fair comparison between multiple tools requires a sufficiently rich gold corpus, both in terms of content and precision of annotations. Since no such corpus was available for French, we created the first balanced-sample freely available gold corpus for NER in French.
15 samples of 1,000 tokens were selected from 13 sources belonging to six different genres (prose, poetry, speech, encyclopedic, multisource and informative) and available under a free license (see table 1). Their publication period ranges from the 18^{th} century to the 21^{st}. The main drawback of this classification is the presence of a multisource category, even though individual sentences could have been distributed across other existing categories.
We chose for our gold annotation a subset of the Quæro tagset (Grouin et al., 2011) which contains eight types and 23 subtypes. More precisely, only the entities, not the components, were annotated. Annotations were added during two academic years by Master's students in computational linguistics using `WebAnno` (de Castilho et al., 2014). The students were given the Quæro annotation guide[7] and were briefly trained before annotating. Each text was annotated by two students, then the annotations were corrected (curated) collaboratively by three NER experts.
We estimated the inter-annotator agreement between the students using Krippendorff's α (Krippendorff, 2013). The overall results for the first campaign reached an α of 0.78$\pm$0.06 with 95% confidence interval (0.82$\pm$0.03 once the worst annotator has been excluded). The second campaign, in which more difficult genres, such as poetry, were annotated, took more time to correct, with an α of 0.35$\pm$0.43[8].
Some of the hardest entities include rare elements such as historical events uneasy to identify (eg. "*conspiration des poudres*", - the "Gunpowder Plot") or religious items (eg. "*Pentateuque*" - "Pentateuch", "*les Écritures*" - "Scriptures"). What is more, we distinguish two types of ambiguïty: - apparent ambiguity which can be resolved with context. These include for instance a series of mythological names which could either refer to *LOC* or *PERS* (eg. "Lesbos" or "Venus"). These probably wrongly annotated by some of the students in reason of the texts' complexity coupled with attention slips. - intrinsinc ambiguity which could either be resolved by a very careful reading of the annotation guidelines, or required a decision. This is the case for entities such as "tourism office", which can be interpreted as *LOC* or *ORG*. We documented our choices along curation to ensure consistency. This documentation is made available with the corpus.

[2] See: `https://spacy.io/models/fr`.
[3] See: `https://huggingface.co/flair/ner-french`.
[4] See `https://huggingface.co/Jean-Baptiste/camembert-ner`.
[5] *amount*, *prod*, *org*, *loc*, *time*, *func*, *per*, *event*.
[6] *ORG*, *LOC*, *PER*, *MISC*.
[7] Available at: `http://www.quaero.org/media/files/bibliographie/quaero-guide-annotation-2011.pdf`.
[8] These agreements were computed using the *Rmisc* library, see: `https://www.rdocumentation.org/packages/Rmisc/versions/1.5`.

Source (identifier)	Period	Genre	Nb. sentences (Nb. tokens)	Licence
Traité sur la Tolérance, Voltaire (42131-0)	18th	prose	40 (1,020)	Project Gutenberg
Le Ventre de Paris, Émile Zola (pg6470)	19th		51 (1,002)	Project Gutenberg
L'Homme qui plantait des arbres, Jean Giono (Wikisource)	20th		53 (1,013)	CC BY-SA 4.0
Les Fleurs du Mal, Baudelaire (pg6099)	19th	poetry	30 (1,014)	Project Gutenberg
Œuvres d'Arthur Rimbaud - Vers et proses (56708-0)	19th		52 (1,027)	Project Gutenberg
UD French GSD	21st	multisources	35 (1,021)	CC BY-SA 4.0
Sequoia (Candito and Seddah, 2012)	21st		44 (1,002)	LGPL-LR
French Question Bank (Seddah and Candito, 2016)	21st		102 (1 006)	LGPL-LR
APIL (office du tourisme Othe-Armance)	21st	information	29 (1,002)	LGPL-LR
Wikinews	21st		46 (1,024)	CC BY 2.5
L'Est Républicain (ATILF and CLLE, 2020)	21st		40 (1,000)	CC BY-SA 2.0
French WikiNER	21st	encyclopedia	36 (1,003)	CC BY 4.0
Rhapsodie (Lacheret et al., 2014)	21st	spoken	213 (3 061) (3 samples)	CC BY-SA 4.0

Table 1: Description of the manually annotated corpus.

amount	*event*	*func*	*loc*	*org*	*pers*	*prod*	*time*
9%	3%	8%	31%	8%	20%	6%	15%

Table 2: Type distribution across the corpus.

After curation, the gold corpus contains 1,124 entities annotated with 31 tags. The distribution across the main types is given in Table 2.

4. Comparing Apples and Oranges

The three annotation schemes used in this work (gold, `CasEN`, and *WikiNER*) are not directly comparable. As a consequence, we measured the adequacy of the schemes and built intermediate mappings between the three tagsets.

4.1. Matching Annotation Schemes

Meta-tags and Evaluation Corpus To evaluate each tool individually, we created two series of meta-tags at the intersection between (i) the gold scheme (eight types that cover 1,124 NEs) and the tagset used by `CasEN` (eight types that cover 1,088 reference NEs), and (ii) the gold scheme and the minimal annotation scheme, which was used in the CoNLL-2003 shared task (Tjong Kim Sang and De Meulder, 2003) and is used by the three other systems (four types that cover 819 of the gold NEs). To enable a basic comparison between tools, we also created a lookup table between the `CasEN` annotation scheme and this minimal one. We call the first intersecting tagset (i) Meta-CasEN, and the second one (ii) Meta-WikiNER. The corresponding mappings are provided in Appendices A.1 and A.2. Entity counts per tagset are given in table 3.[9]
The Quæro annotation scheme being the richest tagset used in this study, the transposition of the gold corpus to the two meta-tagsets causes a diminution of the number of NEs. For example, the entities *amount* and *date* are excluded from the minimal evaluation corpus.

Comparing Annotation Schemes Since we evaluate systems on an annotation scheme that differs from the one they were trained with and for, it is necessary to assess their adequacy, both syntactically and semantically. To do so, we used a *WikiNER* sample on which we compared the semi-automatically created *WikiNER* gold standard (used to train both `SpaCy` and `Flair`, and to finetune `CamemBERT-ner`) with the two variants (Quæro based and minimal) of our gold standard. Table 4 shows the high precision between the tagsets: a *WikiNER* NE is generally a Quæro NE. Recall increases naturally as the tagset gets poorer. We also performed typeless comparisons, which allow us to compare the correspondence between NE spans, which appears to be high.
The main difference we observe between annotation schemes comes from inconsistent NE segmentations due to the semi-automatic annotation of the *WikiNER* corpus. Such inconsistencies include for example the variable inclusion of the determiner before the NE, or the NE being either split into two annotations or considered as single one. The latter is especially true for locations such as "*Chine du Nord*"[10]. Those inconsistencies generate boundary and labeling errors on NEs. There is a high consistency between the minimal and the *WikiNER* annotation schemes (*dates* and *amount* are not labeled ; *prod* annotations become *MISC*). Still, part of the mismatching annotations are due to apparent inconsistencies between the two annotation schemes. For instance, music bands are annotated *ORG* in *WikiNER* and *pers.coll* in Quæro, "New York Times" is annotated *ORG* and *prod.media*. In fact, these differences between the annotation schemes are a direct consequence of the limitations of a coarse-grained 4 label tagset.[11] Some equivalences are up to debate. For instance, we chose to match *func* with *MISC*, but the CONLL-2003 guide (along with an examination of the *WikiNER* annotation) does not

[9] Differences observed in *LOC* and *PROD* counts result from filtering out *loc.add.elec* and *prod.doctr* entities in the mapped corpora (see Appendix A.1.

[10] "Northern China".

[11] The ambiguity with *org.ent* tag is solved in Quæro, section 1.3.4. (Rosset et al., 2011).

Quæro	*amount*	*event*	*func*	*loc*	*org*	*per*	*prod*	*time*	
#	99	31	96	344	92	225	67	170	
Meta-CasEN	*AMOUNT*	*EVENT*	*FUNC*	*LOC*	*ORG*	*PER*	*PROD*	*TIME*	
#	99	31	96	309	92	225	66	170	
Meta-WikiNER				*LOC*	*ORG*	*PER*			*MISC*
#				309	92	225			193

Table 3: Entity counts per tagset.

Tagset	strict			partial		
	P	R	F	P	R	F
Quæro (n/t)	0.91	0.56	0.69	0.95	0.58	0.72
Quæro	0.83	0.51	0.63	0.88	0.53	0.66
minimal (n/t)	0.91	0.83	0.87	0.95	0.86	0.90
minimal	0.84	0.79	0.82	0.89	0.84	0.87

Table 4: Comparison between *WikiNER* and our gold annotations. "n/t" (for *no types*) means that the types were ignored for the comparison.

lead to a clear-cut conclusion. The case of multiple annotations *LOC+ORG*, specific to metonimic NEs[12], leads to a partial match and shows the limitations of the *WikiNER* tagset.
The `CasEN` tagset is closer to the Quæro tagset, both being derived from the *ESTER 2* corpus tagset. The only difference we noticed is that `CasEN` uses the type `ref` for both numerical references (for example "[1]") and for book titles, while only the latter is annotated in Quæro.

4.2. Results

We compared the results of the systems according to different evaluation setups illustrated on Figure 1. The graph on the left shows the strict F-scores reached by genre and on the whole corpus, while the graph on the right gives the absolute number of correct annotations and error types (namely substitution, insertion and deletion, as defined by Galibert et al. (2011)) on the whole corpus only.
Because the reference annotation scheme is rich, we can provide two series of results for `CasEN`. The first one (labeled as `CasEN`) is an autonomous evaluation of the system, evaluated on its target tagset, the second is a reduction of its output to the minimal *WikiNER* scheme (`Minimal-CasEN`)
Globally (with all genres mixed), all systems show similar F-scores, with `CamemBERT-ner` outperforming the three other systems.

We can see the value of using multiple metrics instead of a unique one. Single metric benchmarks do not convey how systems behave on actual data: for instance the `CasEN` system is prone to insertion, deletion and boundary errors but presents the highest score for correct annotation and shows the best performance for the labeling subtask.
What is more, the left part shows that CasEN outperforms `Flair` and `SpaCy` on literary genres. These systems indeed tend to fluctuate with the textual genres, with better performances on the "Multisource" and "Encyclopedic" axes, while the performance of `CasEN` is stable.
The figure also shows that the systems have comparable error profiles. This suggests a potential subset of entities that are harder to properly annotate.

5. Conclusion

We detailed in this paper the work that is required to compare tools developed for the same task. We showed the benefits of building a rich evaluation framework based on an adequate gold reference and explicit metrics. The reference corpus and the mappings between annotation schemes that this comparison requires are freely available.[13] The different textual categories of the gold corpus allows a more accurate evaluation of off-the-shelf systems on various textual genres. This gives an insight on the robustness of these systems, as some genres were absent from their training data.
This study also confirms that challenging systems on a variety of corpora reveals the over-fitting tendencies of some of them.

6. Limitations

We intend to complete the evaluation using the methodology proposed by Fu et al. (2020), who, in order to get a better understanding of errors and possible improvements, use new metrics using NE attributes such as length in number of words, or token frequency and ambiguity. Building interpretable metrics based on meaningful NE traits would allow for a better understanding of the actual performance of the systems. Our experiment could be enriched through a finer per-type analysis.

At the time of this article, our gold corpus contains 15,200 tokens, which is about 40 % of the test set of the reference corpus for written French, the *French Treebank* (Abeillé et al., 2003), as split in Crabbé and Candito (2008). As for sampling,

[12] See section 1.4 of the Quæro annotation guide (Rosset et al., 2011).

[13] See `https://github.com/alicemillour/FENEC`.

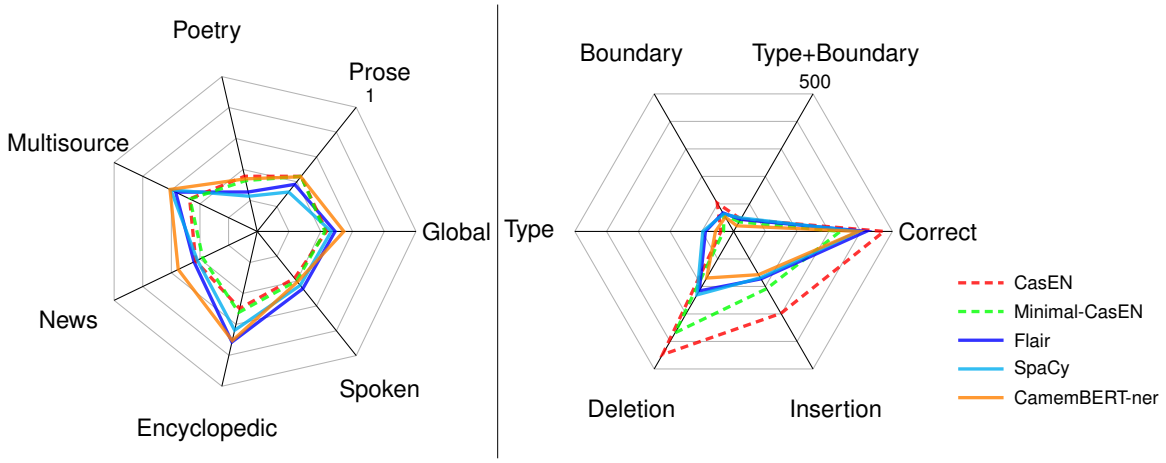

Figure 1: On the left: strict F-measure scores, globally and across the textual genres. On the right: correct annotations and errors (label, boundaries, label+boundaries, deletion, insertion).

while each single sample is of the same size, their distribution across genres is not as well balanced, poetry and encyclopedia being under-represented. A perspective of our work is therefore to extend the corpus and improve its balance across genres at the same time. This work has already started, with the help of our Masters' students.

7. Aknowledgments

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Bibliography

Anne Abeillé, Lionel Clément, and François Toussenel. 2003. Building a treebank for french. In *Treebanks*, pages 165–187. Springer.

Lotfi Abouda and Olivier Baude. 2006. Constituer et exploiter un grand corpus oral: choix et enjeux théoriques. le cas des eslo. In *Corpus en Lettres et Sciences sociales, Des documents numériques à l'interprétation*.

Alan Akbik, Duncan Blythe, and Roland Vollgraf. 2018. Contextual string embeddings for sequence labeling. In *Proceedings of the 27th International Conference on Computational Linguistics*, pages 1638–1649, Santa Fe, Nouveau Mexique, USA. Association for Computational Linguistics.

ATILF and CLLE. 2020. Corpus journalistique issu de l'est républicain. ORTOLANG (Open Resources and TOols for LANGuage) –www.ortolang.fr.

Marie Candito and Djamé Seddah. 2012. Le corpus Sequoia : annotation syntaxique et exploitation pour l'adaptation d'analyseur par pont lexical. In *Actes de Traitement Automatique des Langues Naturelles (TALN)*, Grenoble, France.

Antoine Caubrière, Sophie Rosset, Yannick Estève, Antoine Laurent, and Emmanuel Morin. 2020. Where are we in named entity recognition from speech? In *Proceedings of the 12th Language Resources and Evaluation Conference*, pages 4514–4520, Marseille, France. European Language Resources Association.

Nancy Chinchor and Beth Sundheim. 1993. MUC-5 evaluation metrics. In *Fifth Message Understanding Conference (MUC-5): Proceedings of a Conference Held in Baltimore, Maryland, August 25-27, 1993*.

Benoît Crabbé and Marie Candito. 2008. Expériences d'analyse syntaxique statistique du français. In *15ème conférence sur le Traitement Automatique des Langues Naturelles - TALN'08*, pages pp. 44–54, Avignon, France.

Richard Eckart de Castilho, Chris Biemann, Iryna Gurevych, and Seid Muhie Yimam. 2014. WebAnno: a flexible, web-based annotation tool for CLARIN. In *Proceedings of the CLARIN Annual Conference (CAC) 2014*, page online, Utrecht, Netherlands. CLARIN ERIC. Extended abstract.

Nathalie Friburger and Denis Maurel. 2004. Finite-state transducer cascades to extract named entities in texts. *Theoretical Computer Science*, 313(1):93–104.

Jinlan Fu, Pengfei Liu, and Graham Neubig. 2020. Interpretable multi-dataset evaluation for named entity recognition. In *Proceedings of the 2020 Conference on Empirical Methods in Natural Language Processing (EMNLP)*, pages 6058–6069, Online. Association for Computational Linguistics.

Olivier Galibert, Sophie Rosset, Cyril Grouin, Pierre Zweigenbaum, and Ludovic Quintard.

2011. Structured and extended named entity evaluation in automatic speech transcriptions. In *Proceedings of 5th International Joint Conference on Natural Language Processing*, pages 518–526, Chiang Mai, Thaïlande. Asian Federation of Natural Language Processing.

Sylvain Galliano, Guillaume Gravier, and Laura Chaubard. 2009. The ESTER 2 evaluation campaign for the rich transcription of french radio broadcasts. In *Tenth Annual Conference of the International Speech Communication Association*, pages 2583–2586, Brighton, GB.

Cyril Grouin, Sophie Rosset, Pierre Zweigenbaum, Karën Fort, Olivier Galibert, and Ludovic Quintard. 2011. Proposal for an extension of traditional named entities: From guidelines to evaluation, an overview. In *5th Linguistic Annotation Workshop*, pages 92–100, Portland, Oregon, USA. Poster.

Matthew Honnibal and Ines Montani. 2017. spaCy 2: Natural language understanding with Bloom embeddings, convolutional neural networks and incremental parsing. *To appear*, 7(1):411–420.

Ridong Jiang, Rafael E. Banchs, and Haizhou Li. 2016. Evaluating and combining name entity recognition systems. In *Proceedings of the Sixth Named Entity Workshop*, pages 21–27, Berlin, Germany. Association for Computational Linguistics.

Klaus Krippendorff. 2013. *Content Analysis: An Introduction to Its Methodology*, 3rd edition edition. Sage, Thousand Oaks, CA.

Anne Lacheret, Sylvain Kahane, Julie Beliao, Anne Dister, Kim Gerdes, Jean-Philippe Goldman, Nicolas Obin, Paola Pietrandrea, and Atanas Tchobanov. 2014. Rhapsodie: un Treebank annoté pour l'étude de l'interface syntaxe-prosodie en français parlé. In *4e Congrès Mondial de Linguistique Française*, volume 8, pages 2675–2689, Berlin, Allemagne.

John Makhoul, Francis Kubala, Richard Schwartz, and Ralph Weischedel. 1999. Performance measures for information extraction. In *Proceedings of DARPA Broadcast News Workshop*, pages 249–252.

Chester Palen-Michel, Nolan Holley, and Constantine Lignos. 2021. SeqScore: Addressing barriers to reproducible named entity recognition evaluation. In *Proceedings of the 2nd Workshop on Evaluation and Comparison of NLP Systems*, pages 40–50, Punta Cana, Dominican Republic. Association for Computational Linguistics.

Sophie Rosset, Cyril Grouin, and Pierre Zweigenbaum. 2011. *Entités Nommées Structurées : guide d'annotation Quaero*. Notes et Documents LIMSI N° : 2011-04. LIMSI-Centre national de la recherche scientifique. http://www.quaero.org/media/files/bibliographie/quaero-guide-annotation-2011.pdf.

Xavier Schmitt, Sylvain Kubler, Jérémy Robert, Mike Papadakis, and Yves Le Traon. 2019. A replicable comparison study of NER software: StanfordNLP, NLTK, OpenNLP, SpaCy, Gate. In *Sixth International Conference on Social Networks Analysis, Management and Security, SNAMS 2019*, Grenada, Spain.

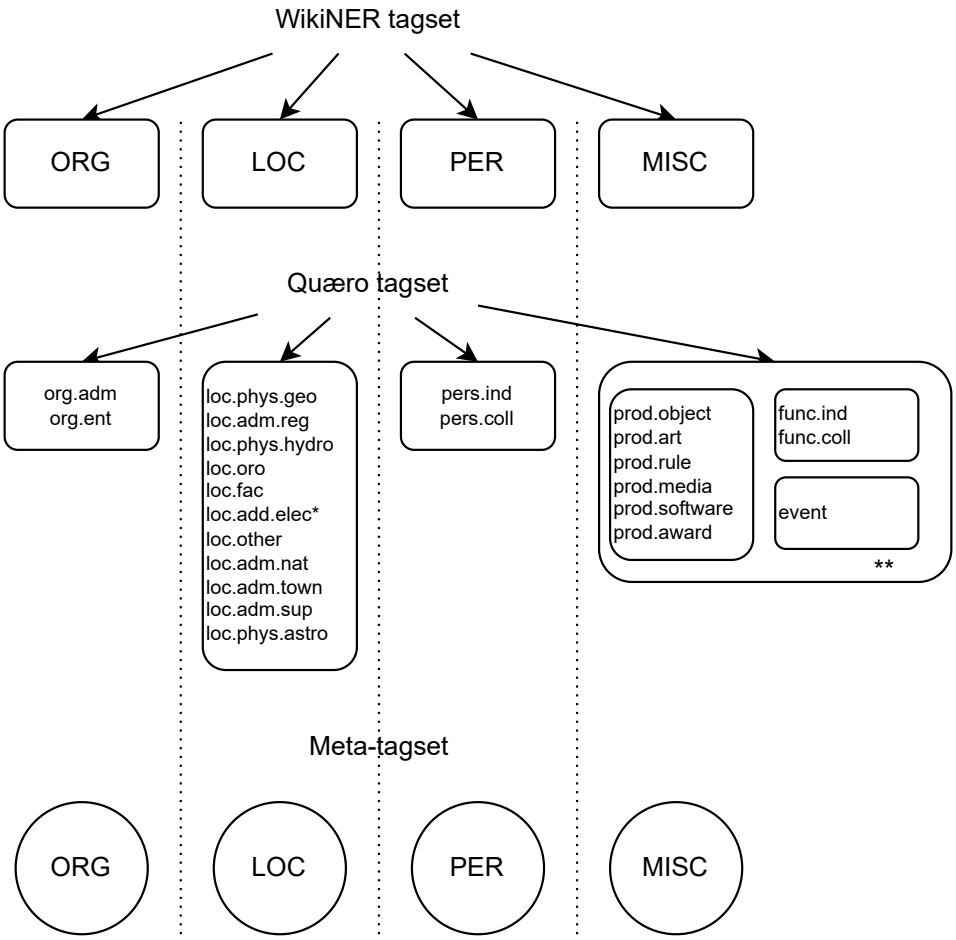
Djamé Seddah and Marie Candito. 2016. Hard time parsing questions: Building a QuestionBank for French. In *Proceedings of the Tenth International Conference on Language Resources and Evaluation (LREC'16)*, pages 2366–2370, Portoroz, Slovenia. European Language Resources Association (ELRA).

Isabel Segura-Bedmar, Paloma Martínez, and María Herrero-Zazo. 2013. SemEval-2013 task 9 : Extraction of drug-drug interactions from biomedical texts (DDIExtraction 2013). In *Second Joint Conference on Lexical and Computational Semantics (*SEM), Volume 2: Proceedings of the Seventh International Workshop on Semantic Evaluation (SemEval 2013)*, pages 341–350, Atlanta, Georgia, USA. Association for Computational Linguistics.

Erik F. Tjong Kim Sang and Fien De Meulder. 2003. Introduction to the CoNLL-2003 shared task: Language-independent named entity recognition. In *Proceedings of the Seventh Conference on Natural Language Learning at HLT-NAACL 2003*, pages 142–147.

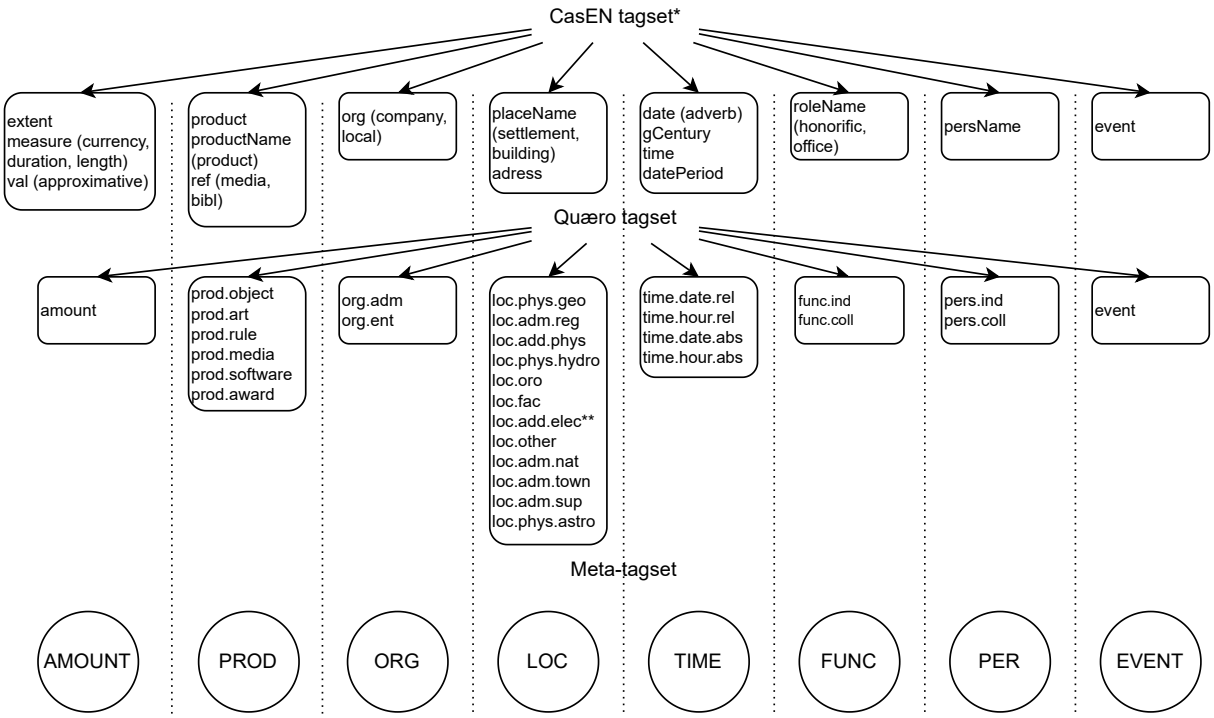
A. Appendix

A.1. Minimal meta-tagset used to evaluate SpaCy and Flair



*loc.add.elec are filtered out from the LOC annotations since they are not annotated as such by the systems
** This type groups any annotation that could be annotated as MISC

A.2. Minimal meta-tagset used to evaluate `CasEN`



* the *nationality* tag was excluded
** loc.add.elec are filtered out from the LOC annotations since they are not annotated as such by the systems