Textinator: an Internationalized Tool for Annotation and Human Evaluation in Natural Language Processing and Generation

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Abstract

We release an internationalized annotation and human evaluation bundle, called Textinator, along with documentation and video tutorials. Textinator allows annotating data for a wide variety of NLP tasks, and its user interface is offered in multiple languages, lowering the entry threshold for domain experts. The latter is, in fact, quite a rare feature among the annotation tools, that allows controlling for possible unintended biases introduced due to hiring only English-speaking annotators. We illustrate the rarity of this feature by presenting a thorough systematic comparison of Textinator to previously published annotation tools along 9 different axes (with internationalization being one of them). To encourage researchers to design their human evaluation before starting to annotate data, Textinator offers an easy-to-use tool for human evaluations allowing importing surveys with potentially hundreds of evaluation items in one click. We finish by presenting several use cases of annotation and evaluation projects conducted using pre-release versions of Textinator. The presented use cases do not represent Textinator’s full annotation or evaluation capabilities, and interested readers are referred to the online documentation for more information.

Keywords: annotation tool, human evaluation tool, natural language processing, natural language generation

1. Introduction

Large-scale pretrained language models, also called foundation models, have brought substantial advances to the Natural Language Processing (NLP) field. Indeed, currently the dominant approach for many NLP tasks is to fine-tune a foundation model on relatively small amounts of task-specific annotated data (Bommasani et al., 2021, Section 2.1.2). These recent developments introduce two major shifts to the field. The first shift is from focusing on large variable-quality crowdsourced annotated datasets back to relatively small high-quality datasets. The second shift is from focusing mostly on methods to focusing mostly on evaluation. In this paper we attempt at addressing both shifts by presenting a tool, called Textinator, suitable for annotating data for a wide variety of NLP tasks, as well as facilitating human evaluation.

Addressing the first shift in more detail, we believe that first and foremost, high-quality data should have correct and consistent annotations. Such annotations are easier to obtain with the help of domain experts, who are, evidently, more expensive to hire than crowd-workers. This is why annotation tools should have a low entry threshold and require no specialized training. Secondly, high-quality data should limit biases only to those necessary for exploring the concept at hand. For instance, factual question answering datasets will necessarily be biased towards wh-questions, but will usually not contain why-questions.

\footnote{Both the code and the documentation are available at \url{https://github.com/dkalpakchi/Textinator} (DOI: \url{10.5281/zenodo.6497334})}

One very subtle (and usually unintended) way of introducing bias in the data is recruiting annotators based on their knowledge of English, since an annotation tool at hand offers UI only in English. Unless data collection happens in an English-speaking country, knowledge of English correlates positively with high socio-economic status (McCormick, 2013). Such bias might not always be desirable, especially for the studies aimed at language perception. For instance, researchers interested in studying language toxicity might want to recruit participants with different socio-economic backgrounds to accommodate differences in the perception of toxicity.

The observation above prompts modern annotation tools to be internationalized and localized into as many languages as possible. Localization refers to the process of providing translations of UI elements into different languages (usually done by translators). The process of preparing software for localization is referred to as internationalization (usually done by engineers). If annotations are done for language other than English, localized software will not only allow controlling for the aforementioned type of bias, but will most certainly lower the entry threshold for domain experts. While trained linguists might know the English names for linguistic phenomena (although it tends to vary across the countries), annotating using linguistic terms in their mother tongue will most certainly lower their cognitive load (and thus annotation time).

Addressing the second shift (from focusing mostly on methods to focusing mostly on evaluation), we note that human-in-the-loop evaluation will probably turn out to be critical for natural language generation (NLG)
tasks (Bommasani et al., 2021, Section 4.4). Indeed, while fine-tuned foundation models are capable of generating texts that appear coherent and well-structured, it is quite often not the case when looking closer. Dou et al. (2021) encountered a wide range of errors including those related to fact truthfulness, redundancy, and common sense, to name a few. Kirk et al. (2021) report that texts generated with GPT-2 contain occupational biases related to gender and ethnicity. Capturing such errors requires a more in-depth human evaluation of NLG models. We believe that the best way forward is to design human evaluations for NLG models before the actual data collection has even started! Our way of encouraging this is by providing an easy-to-use evaluation tool bundled together with an annotation tool. Indeed, Textinator is released in hopes that it will facilitate constructing datasets in many languages and conducting thorough human evaluations faster, at least for some NLG tasks.

2. Comparison to Other Tools

2.1. Annotation Tools

The number of annotation tools has skyrocketed over the years providing a rich variety to choose from. To make the comparison systematic, we have defined a number of axes to compare along. We want to emphasize that we performed the comparison based on the information provided in the published papers (if available) and/or the official documentation (if available). We have neither run any of the tools ourselves, nor looked at the source code, nor contacted the authors. In case the tool has an enterprise version, we evaluate only parts freely available to the public.

Axis 1: Task Type Coverage

We consider only within-document annotation task types, thus excluding between-document annotation tasks (e.g., multi-document summarization) or tasks binding current document with external sources (e.g., entity linking). The exact list of considered task types is provided in Figure 1 and exemplified below.

AT1 Named entity recognition or extractive summarization are instances of span labeling: the act of marking a span of words in the text and annotating it with a label representing a concept of interest.

AT2 Pronoun resolution is an instance of relation annotation: the act of binding two previously labeled text spans and annotating this binding with a named relation.

AT3 Dependency tree annotation is, evidently, an instance of tree annotation. Although trees can be represented as sets of relations, they might require a different UI to speed up the annotation.

AT4 Multiple choice question generation is an instance of marker group annotation: the act of marking a number of spans by different labels and submitting them as a unit (or providing free text, instead of labeling).

AT5 Multiple choice question complexity ranking is an instance of marker group ranking: the act of ordering previously annotated marker groups with respect to a pre-defined criterion.

AT6 Text classification is an instance of text labeling: the act of annotating the whole text with a label, representing the concept of interest.

AT7 Ordering restoration of scrambled sentences is an instance of text ordering: the act of annotating each sentence with an order of appearance in the original text.

AT8 Sentiment annotation is an instance of numerical annotation: the act of associating a number (integer or floating-point) with a text/sentence.

AT9 Abstractive text summarization or machine translation are instances of free-text annotation: the act of associating a free text with the whole text/sentence.

Figure 1: Task types for a within-document annotation
We have categorized annotation tools based on how many task types they support. We consider the task type to be supported if it is possible to annotate at least one task of this type. Using the definition above, we have adopted the following categorization.

- ✔ “limited”, ≤ 3 supported task types;
- ✔ “moderate”, 3 < supported task types ≤ 6;
- ✔ “extensive”, > 6 supported task types.

The comparison results for this axis are presented in the column A1 of Table 1 with extensive details in Table 2 of Appendix.

**Axis 2: Internationalization**

First and foremost, we assume that all tools support Unicode input texts, since all major programming languages provide Unicode support by default. One potential problem might be in displaying right-to-left languages, which is, however, impossible to assess by only reading papers and documentation, hence the assumption. With this assumption in mind, we have assessed the degree of internationalization according to the number of internationalized UI parts. We consider a UI part to be internationalized if:

- it is translated into at least 2 languages;
- a clear mechanism of supplying translations of UI elements is documented;
- it is possible for the annotator to switch the language using UI interactions.

For the purpose of this paper, we consider the following UI parts: static UI elements (e.g., menu items), static markers (supplied with the tool), static relations, dynamic markers (created by users on the fly with user-supplied translations) and dynamic relations. One could argue that internationalization of dynamic markers is not a necessity and one could simply provide translations to a local language directly. However, internationalization is crucial if researchers aim to use the same annotation scheme across languages, as for example Universal Dependencies (Nivre et al., 2020) do. The annotators creating UD-based part-of-speech datasets would mark nouns as “noun” for English, “substantiv” for Swedish or “іменник” for Ukrainian, whereas all exported datasets would contain one and only label NOUN.

Bearing in mind the points above, we have then discretized the degree of internationalization as follows.

- ✗ “none”, no internationalized parts;
- ✔ “limited”, 1 internationalized part;
- ✔ “moderate”, 2 internationalized parts;
- ✔ “extensive”, 3 or more internationalized parts.

The comparison results for this axis are presented in the column A2 of Table 1 with extensive details in Table 3 of Appendix.

**Axis 3: Customization**

We have assessed the degree of customization according to how flexible one can be with the definition of the annotation tasks. Specifically, we have looked whether the following objectives can be achieved.

- C1 Can custom markers for spans of text be defined?
- C2 Can the appearance of the markers be customized?
- C3 Can custom hotkeys be defined for markers?
- C4 Can custom information be associated with markers (e.g., free-text comments)?
- C5 Can custom relations be created for markers?
- C6 Can custom constraints on the relations be specified?
- C7 Can the appearance of relations be customized?
- C8 Can custom hotkeys be defined for relations?
- C9 Can custom marker groups be defined to be annotated as a unit?
- C10 Can the appearance of marker groups be customized?
- C11 Can custom constraints on marker groups be specified?
- C12 Can the annotation UI layout be customized?

If an objective can be achieved using only UI interactions, a tool scored 1 point for the objective. If an objective is possible to achieve through other means of configuration that **do NOT require programming skills**, e.g., via configuration files, a tool scored 0.5 points for the objective. In all other cases a tool scored 0 points for the objective. Based on the final number of points we have defined 4 roughly equal categories.

- ✗ “none”, 0 points
- ✔ “limited”, 0 < points < 4
- ✔ “moderate”, 4 ≤ points < 7
- ✔ “extensive”, ≥ 7 points

The comparison results for this axis are presented in the column A3 of Table 1 with extensive details in Table 4 of Appendix.

**Axis 4: Annotation Progress Tracking**

Tracking annotation progress is vital. This includes, but is not limited to, getting a birds-eye-view on the aspects on the annotated data (e.g., distribution of markers or distribution of marker lengths), tracking the data source progress (e.g., how much of the data was already annotated, if there were any problems with any of the texts) or being able to identify problematic annotation cases marked by the annotators. It is hard to define the exact list of mandatory features for this axis, which is why we simply use the number of relevant features to divide tools into the following categories.
With that in mind, we defined “administration quality” as the availability of features related to administering the project, but not the annotation process itself. For instance, if annotators are employed at hourly rate, the tool should be able to provide an estimate of the spent time each month. The availability of different roles per user (e.g., annotators, reviewers, translators) helps ensuring that every user has access only to parts of the data and interface they need. Again, it is hard to define the exact list of mandatory features, so we use exactly the same scale as for the Axis 4. The comparison results for this axis are presented in the column A6 of Table 1 with extensive details in Table 8 of Appendix.

**Axis 7: Documentation Quality**

Well-documented tools are easier to use than undocumented and the more interactivity the documentation provides, the better. We have considered the following criteria in our assessment:

- C1 whether text-form tutorials are provided;
- C2 whether video tutorials are provided;
- C3 whether sandbox demo is provided;
- C4 whether source code documentation is provided for those with programming skills wishing to extend the tool.

Based on the final number of fulfilled criteria we have defined the following 4 categories.

- ✗ “none”, no fulfilled criteria;
- ✔️ “limited”, 1 fulfilled criterion;
- ✔️ “moderate”, 2 fulfilled criteria;
- ✔️ “extensive”, 3 or more fulfilled criteria.

The comparison results for this axis are presented in the column A7 of Table 1 with extensive details in Table 9 of Appendix.
**Axis 8: Intelligent Assistance**

Scaling up data collection in a time-efficient manner would be facilitated if the tool included some kind of intelligent assistance to the annotator. We have considered the following criteria in our assessment:

- C1 whether annotation suggestions are provided on the fly out of the box by the tool itself;
- C2 whether there is clear method to connect external models for suggestions the fly;
- C3 whether there is a possibility of pre-annotating texts;
- C4 whether custom suggestion models can be trained on already annotated data and then used for automatic annotation;
- C5 whether configurable sanity checks are available (e.g., everything needed is provided);
- C6 whether active learning is possible;
- C7 whether spelling correction is available;
- C8 whether grammar correction is available.

Based on the final number of fulfilled criteria we have defined the following 4 categories.

- ❌ “none”, no fulfilled criteria;
- ✔️ “limited”, 1 fulfilled criterion;
- ✔️ “moderate”, 2 or 3 fulfilled criteria;
- ✔️ “extensive”, 4 or more fulfilled criteria.

The comparison results for this axis are presented in the column A8 of Table 1 with extensive details in Table 9 of Appendix.

**Axis 9: Deployment Mode**

We distinguish between a standalone desktop application (desk◎op), a web application that needs installation on a server (♂server), and a dockerized web application (♀docker).

### 2.2. Evaluation Tools

As mentioned previously, human evaluation in NLG is bound to become more important. To the best of our knowledge, currently researchers are utilizing external web-based survey software, such as Google Forms, SurveyMonkey, Qualtrics, etc. However, we find that these services have two major problems. First, they require manual input, which might end up being quite tedious if the task is, say, to evaluate 50 generated texts by 3 different models according to a number of different criteria. Second, researchers based in the EU need to spend extra effort to comply with GDPR (for instance, by ensuring that their surveys are hosted on the EU servers). These two aspects led us to implement a human evaluation tool, called Textinator Surveys (TS). TS can be hosted on the university servers after a simple Docker-based installation, thus solving a GDPR issue. TS also allows importing surveys from a JSON file, in which both the survey’s configuration and the items themselves can be specified. TS takes care of item randomization and allows associating meta-information (invisible to a human evaluator) with survey items, which might be very useful for a researcher in the analysis afterwards. See more about the capabilities of TS (and Textinator in general) in the documentation or video tutorial.

### 3. Use Cases

Pre-release versions of Textinator were used both for annotating new datasets and conducting human evaluation in a number of projects, which we briefly present below. Note that in all provided screenshots, the UI localization is turned off for the benefit of the reader of this article, whereas annotated texts are provided in their original language.

#### 3.1. Annotation

- Ahlenius (2020) annotated a pronoun resolution dataset for Swedish using one of the earliest versions of Textinator (current UI for this task is shown in Figure 2).
- Kalpakchi and Boye (2021a) used Textinator for annotating a dataset of multiple choice questions in Swedish (see Figure 3 for the UI configuration).
- Tengvall (2020) annotated a question answering dataset in Swedish using Textinator’s configuration similar in Figure 3, but without the red “Distractor” markers.

#### 3.2. Human Evaluation

- Lindqvist (2021) used Textinator for evaluating the quality of automatically generated question paraphrases in Swedish. Both extensive HTML guidelines (see Figure 5) and the survey items themselves (see Figure 4) were provided using the “Import from JSON” functionality.
- Kalpakchi and Boye (2021b) used Textinator for evaluating the quality of generated question-answer pairs in 4 different languages (see Figure 6).
- Kalpakchi and Boye (2021a) used Textinator for evaluating the quality of generated distractors in Swedish (see Figure 7). The HTML highlighting for parts of the text was also specified using the import functionality.

### 4. Acknowledgements

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[3] https://www.google.com/forms/about/
[4] https://www.surveymonkey.com/
[5] https://www.qualtrics.com

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Figure 2: Textinator’s UI for pronoun resolution

Figure 3: Textinator’s UI for multiple choice question answering task

Figure 4: Textinator’s UI for paraphrase quality evaluation used
Figure 5: Textinator’s UI for evaluation guidelines

Figure 6: Textinator’s UI for question-answer pair quality evaluation

Figure 7: Textinator’s UI for distractor quality evaluation form
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Appendix: Details of the Comparison of Annotation Tools

In this appendix we provide detailed explanation for the scores assigned in Table [1]. For typographic purposes, we have assigned each annotation tool under comparison a unique identifier as follows.

T1 WordFreak (Morton and LaCivita, 2003)
T2 MMAX2 (Müller and Strube, 2006)
T3 BRAT (Stenetorp et al., 2012)
T4 WebAnno (Yimam et al., 2013)
T5 GATE Teamware (Bontcheva et al., 2013)
T6 INCEpTION (Klie et al., 2018)
T7 AWOCATo (Daudert, 2020)
T8 Doccano (Nakayama et al., 2018)
T9 Label Studio (Tkachenko et al., 2020)
T10 Textinator (ours)

Please see Tables 2 to 9 on the next pages.
| Tool | Task types |
|------|------------|
| T1   | trees (constituency and dependency parsing), span markers (named entity recognition), relations (coreferences) |
| T2   | span markers (cfg), relations (cfg), trees (dependency) |
| T3   | relations (cfg), trees (dependency), span markers (cfg) |
| T4   | span-based (cfg), relations (cfg), trees (dependency) |
| T5   | span-based (cfg), relations (cfg) |
| T6   | span-based (cfg), relations (cfg), trees (dependency), free-text information (via document metadata) |
| T7   | real-valued numbers (sentiment annotation), text markers (binary or tertiary text classification), free-text information (cfg) |
| T8   | span markers (cfg), text markers (cfg), free-text information (machine translation) |
| T9   | span markers (named entity recognition), text markers (cfg), relations (cfg) |
| T10  | span markers (cfg), relations (cfg), marker groups (cfg), ranked marker groups (cfg), text markers (cfg), real-valued numbers (cfg), free-text information (cfg) |

Table 2: Detailed comparison results for the task coverage axis (A1). “cfg” stands for “configurable” and means that many annotation tasks of this type could potentially be created.

| C1: static UI elements | T1 | T2 | T3 | T4 | T5 | T6 | T7 | T8 | T9 | T10 |
|------------------------|----|----|----|----|----|----|----|----|----|-----|
| ✗                      | ✔  | ✔  | ✗  | ✗  | ✗  | ✔  | ✗  | ✗  | ✔  | ✔   |

| C2: static markers     | T1 | T2 | T3 | T4 | T5 | T6 | T7 | T8 | T9 | T10 |
|------------------------|----|----|----|----|----|----|----|----|----|-----|
| ✗                      | ✔  | ✔  | ✗  | ✗  | ✗  | ✔  | ✗  | ✗  | ✔  | ✔   |

| C2: static relations   | T1 | T2 | T3 | T4 | T5 | T6 | T7 | T8 | T9 | T10 |
|------------------------|----|----|----|----|----|----|----|----|----|-----|
| ✗                      | ✔  | ✔  | ✗  | ✗  | ✗  | ✔  | ✗  | ✗  | ✔  | ✔   |

| C3: dynamic markers    | T1 | T2 | T3 | T4 | T5 | T6 | T7 | T8 | T9 | T10 |
|------------------------|----|----|----|----|----|----|----|----|----|-----|
| ✗                      | ✔  | ✔  | ✗  | ✗  | ✗  | ✔  | ✗  | ✗  | ✔  | ✔   |

| C3: dynamic relations  | T1 | T2 | T3 | T4 | T5 | T6 | T7 | T8 | T9 | T10 |
|------------------------|----|----|----|----|----|----|----|----|----|-----|
| ✗                      | ✔  | ✔  | ✗  | ✗  | ✗  | ✔  | ✗  | ✗  | ✔  | ✔   |

Table 3: Detailed comparison results for the internationalization axis (A2).

| C1: Custom markers for spans of text | T1 | T2 | T3 | T4 | T5 | T6 | T7 | T8 | T9 | T10 |
|--------------------------------------|----|----|----|----|----|----|----|----|----|-----|
| ✗                                    | ✔  | ✔  | ✗  | ✗  | ✗  | ✔  | ✗  | ✗  | ✔  | ✔   |

| C2: Custom appearance of the markers | T1 | T2 | T3 | T4 | T5 | T6 | T7 | T8 | T9 | T10 |
|-------------------------------------|----|----|----|----|----|----|----|----|----|-----|
| ✗                                    | ✔  | ✔  | ✗  | ✗  | ✗  | ✔  | ✗  | ✗  | ✔  | ✔   |

| C3: Custom hotkeys for markers?      | T1 | T2 | T3 | T4 | T5 | T6 | T7 | T8 | T9 | T10 |
|-------------------------------------|----|----|----|----|----|----|----|----|----|-----|
| ✗                                    | ✔  | ✔  | ✗  | ✗  | ✗  | ✔  | ✗  | ✗  | ✔  | ✔   |

| C4: Custom information associated with any of the markers | T1 | T2 | T3 | T4 | T5 | T6 | T7 | T8 | T9 | T10 |
|----------------------------------------------------------|----|----|----|----|----|----|----|----|----|-----|
| ✗                                                        | ✔  | ✔  | ✗  | ✗  | ✗  | ✔  | ✗  | ✗  | ✔  | ✔   |

| C5: Custom relations for the markers?                     | T1 | T2 | T3 | T4 | T5 | T6 | T7 | T8 | T9 | T10 |
|----------------------------------------------------------|----|----|----|----|----|----|----|----|----|-----|
| ✗                                                        | ✔  | ✔  | ✗  | ✗  | ✗  | ✔  | ✗  | ✗  | ✔  | ✔   |

| C6: Custom constraints on the relations                   | T1 | T2 | T3 | T4 | T5 | T6 | T7 | T8 | T9 | T10 |
|----------------------------------------------------------|----|----|----|----|----|----|----|----|----|-----|
| ✗                                                        | ✔  | ✔  | ✗  | ✗  | ✗  | ✔  | ✗  | ✗  | ✔  | ✔   |

| C7: Custom appearance of relations                         | T1 | T2 | T3 | T4 | T5 | T6 | T7 | T8 | T9 | T10 |
|----------------------------------------------------------|----|----|----|----|----|----|----|----|----|-----|
| ✗                                                        | ✔  | ✔  | ✗  | ✗  | ✗  | ✔  | ✗  | ✗  | ✔  | ✔   |

| C8: Custom hotkeys for relations                           | T1 | T2 | T3 | T4 | T5 | T6 | T7 | T8 | T9 | T10 |
|----------------------------------------------------------|----|----|----|----|----|----|----|----|----|-----|
| ✗                                                        | ✔  | ✔  | ✗  | ✗  | ✗  | ✔  | ✗  | ✗  | ✔  | ✔   |

| C9: Custom marker groups to be annotated as a unit         | T1 | T2 | T3 | T4 | T5 | T6 | T7 | T8 | T9 | T10 |
|----------------------------------------------------------|----|----|----|----|----|----|----|----|----|-----|
| ✗                                                        | ✔  | ✔  | ✗  | ✗  | ✗  | ✔  | ✗  | ✗  | ✔  | ✔   |

| C10: Custom appearance of marker groups                    | T1 | T2 | T3 | T4 | T5 | T6 | T7 | T8 | T9 | T10 |
|-----------------------------------------------------------|----|----|----|----|----|----|----|----|----|-----|
| ✗                                                        | ✔  | ✔  | ✗  | ✗  | ✗  | ✔  | ✗  | ✗  | ✔  | ✔   |

| C11: Custom constraints on the marker groups               | T1 | T2 | T3 | T4 | T5 | T6 | T7 | T8 | T9 | T10 |
|-----------------------------------------------------------|----|----|----|----|----|----|----|----|----|-----|
| ✗                                                        | ✔  | ✔  | ✗  | ✗  | ✗  | ✔  | ✗  | ✗  | ✔  | ✔   |

| C12: Custom UI layout (to any degree)                      | T1 | T2 | T3 | T4 | T5 | T6 | T7 | T8 | T9 | T10 |
|-----------------------------------------------------------|----|----|----|----|----|----|----|----|----|-----|
| ✗                                                        | ✔  | ✔  | ✗  | ✗  | ✗  | ✔  | ✗  | ✗  | ✔  | ✔   |

Table 4: Detailed comparison results for the customization axis (A3). ✗ denotes that the objective can be achieved via UI interactions, ✘ denotes that it can be achieved only by means other than UI interactions, but requires no programming skills, ✕ denotes that it cannot be achieved or programming skills are required.
| Tool  | Features                                                                                     |
|-------|---------------------------------------------------------------------------------------------|
| T1    | found none                                                                                  |
| T2    | found none                                                                                  |
| T3    | an address for each annotation; detailed annotation process measurement                    |
| T4    | project progress as an annotator-document matrix; progress of individual annotator; dataset completion statistics. |
| T5    | annotation status monitoring (displayed as pie charts); tracking average annotation time; per-annotator statistics; per-document statistics |
| T6    | an overview which documents have already been annotated and who annotated them; statistics about the annotated tokens and sentences (using MTAS); progress of individual annotator; |
| T7    | found none                                                                                  |
| T8    | found none                                                                                  |
| T9    | found none in the community edition                                                         |
| T10   | dataset completion statistics; user progress tracking; distribution of the annotation lengths; flagging problems with text |

Table 5: Detailed comparison results for the annotation progress tracking axis (A4)

| Tool  | Features                                                                                     |
|-------|---------------------------------------------------------------------------------------------|
| T1    | found none                                                                                  |
| T2    | list-based visualization and highlighting of differences; Kappa statistic for nominal attributes; calculating inter-annotator agreement for relations |
| T3    | integrated annotation comparison                                                            |
| T4    | the curator can open and compare annotations made by multiple annotators; the curator can reconcile annotations; can calculate Kappa and Tau measures |
| T5    | calculates IAA metrics (including f-measure and Kappa); a visual annotation comparison tool; adjudication editor to reconcile annotations |
| T6    | calculates IAA metrics (Cohen’s kappa, Fleiss’ kappa, Krippendorff’s alpha); UI for merging annotations; handling abandoned documents by reassining annotators after time-out. |
| T7    | automatic consolidation if the number of required annotations per text, and the stipulated standard deviation are defined; manual consolidation |
| T8    | found none                                                                                  |
| T9    | found none in the community edition                                                         |
| T10   | none                                                                                        |

Table 6: Detailed comparison results for the quality assurance axis (A5)
T1 found none
T2 found none
T3 found none
T4 separate roles for annotator, curator and project manager;
T5 out-of-the-box roles of administrator, project manager and annotator; the possibility to define custom roles; defining number of annotators per document; benchmarking annotator’s performance against gold data; defining workflows as custom graph-based schemas
T6 separate roles for annotator, administrator, project creator, or remote API access; dynamic assignment if you want each document to be annotated by a certain number of annotators; project versioning; guest annotators; invite links
T7 found none
T8 a separate role for annotator
T9 found none in the community edition
T10 separate roles for annotator, project manager, translator and system administrator; custom roles can be defined; defining whether each document will be annotated once or by each annotator; monthly time reports per annotator

Table 7: Detailed comparison results for the administration quality axis (A6)

|       | T1 | T2 | T3 | T4 | T5 | T6 | T7 | T8 | T9 | T10 |
|-------|----|----|----|----|----|----|----|----|----|-----|
| C1:  |    | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔   |
| C2:  |    | ✘  | ✘  | ✘  | ✔  | ✘  | ✘  | ✔  | ✔  | ✔   |
| C3:  | ✔  | ✔  | ✔  | ✔  | ✔  | ✘  | ✘  | ✔  | ✔  | ✔   |
| C4:  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔   |

Table 8: Detailed comparison results for the documentation quality axis (A7)

|       | T1 | T2 | T3 | T4 | T5 | T6 | T7 | T8 | T9 | T10 |
|-------|----|----|----|----|----|----|----|----|----|-----|
| C1:  | ✔  | ✔  | ✔  | ✔  | ✘  | ✘  | ✘  | ✘  | ✘  | ✘   |
| C2:  | ✔  | ✔  | ✔  | ✔  | ✘  | ✘  | ✘  | ✔  | ✔  | ✔   |
| C3:  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔   |
| C4:  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔   |
| C5:  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔   |
| C6:  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔   |
| C7:  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔   |
| C8:  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔   |

Table 9: Detailed comparison results for the intelligent assistance axis (A8)