Guidelines and a Corpus for Extracting Biographical Events

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Abstract

Despite biographies are widely spread within the Semantic Web, resources and approaches to automatically extract biographical events are limited. Such limitation reduces the amount of structured, machine-readable biographical information, especially about people belonging to underrepresented groups. Our work challenges this limitation by providing a set of guidelines for the semantic annotation of life events. The guidelines are designed to be interoperable with existing ISO-standards for semantic annotation: ISO-TimeML (SO-24617-1), and SemAF (ISO-24617-4). Guidelines were tested through an annotation task of Wikipedia biographies of underrepresented writers, namely authors born in non-Western countries, migrants, or belonging to ethnic minorities. 1,000 sentences were annotated by 4 annotators with an average Inter-Annotator Agreement of 0.825. The resulting corpus was mapped on OntoNotes. Such mapping allowed to to expand our corpus, showing that already existing resources may be exploited for the biographical event extraction task.

Keywords: Event Extraction, Semantic Annotation, Interoperability

1. Introduction

The Semantic Web shift led in few years to a growth of biographical information online. Knowledge Graphs (KG), such as Dbpedia [Auer et al., 2007] and Wikidata [Vrandečić and Krötzsch, 2014], allow the gathering of structured socio-demographic attributes and facts about people. Notwithstanding, many unstructured data conveying biographical information are still not mapped in KGs. Wikipedia pages express more content than their corresponding Wikidata profile: for instance, all the places where a person lived within their life and all their migrations. The enrichment of existing KGs with such information would be crucial in improving several tasks such as community detection [Wang et al., 2018], prosopography [Booth, 2008], and social bias detection [Sun and Peng, 2021].

Although several semantic models have been proposed to formally represent a biographical event [Krieger and Declerck, 2015], [Tuominen et al., 2018], computational resources for the automatic extraction of biographical events from text are still missing, and there are no annotated corpora, nor annotation schemes specifically designed for this task.

In this paper, we describe a novel set of annotation guidelines specifically developed for this task, built on two Semantic Annotation Frameworks, ISO 24617-1 (Pustejovsky et al., 2010), and ISO 24617-4 (Bunt and Palmer, 2013). The guidelines have been adopted to annotate a corpus of 1,000 sentences extracted from Wikipedia pages of under-represented writers, namely writers born in non-Western countries, migrants or belonging to ethnic minorities (Stranisci et al., 2021b). The resource is designed to be interoperable with existing language resources (Pustejovsky et al., 2003; Hoey et al., 2006), in order to augment the corpus with additional data through a systematic mapping. Such data augmentation is crucial for the future implementation of a pipeline for the automatic extraction of biographical events.

The paper is structured as follow. In Section 2, a review of works on biographical encoding and event extraction is provided. Section 3 describes data collection and annotation guidelines design. In Section 4 results of the annotation are presented. Section 5 presents the mapping of the resource with existing corpora. Finally, Section 6 concludes the paper with some insights on future work.

2. Related Work

The extraction of biographical events from text brings into play two main research lines, namely...

Semantic Roles and Events Annotation Frameworks. The annotation of semantic roles has been addressed by a number of approaches with specific focuses (see Petukhova and Bunt (2008)). FrameNet (FN) [Baker et al., 1998] and PropBank (PB) [Kingsbury and Palmer, 2002] are two databases of semantic roles: the former is not syntactically bounded and relies on a detailed taxonomy of semantic roles; the latter is centered on verbs and the classification of arguments is coarse-grained. Other approaches are focused on a general notion of semantic role. VerbNet’s (VN) [Schuler, 2005] aim is the classification of English verbs on the basis of semantic-syntactic properties; LIRICS identifies ‘relational notions which link a participant to some real or imagined situation (‘event’)’ [Bunt and Romary, 2002]. In last years, attempts to unify such resources have been made. The Semantic Annotation Framework (SemAF) [Bunt and Palmer, 2013] provides an unifying framework according to which a semantic annotation relies on a finite set of eventualities (EV) and participants (PT) that form entity structure pairs with...
markables, namely tokens to which an EV or PT can be attached. Pairs are then combined in links through link structure. For instance, in the sentence ‘she published poetry’ three entity structure pairs may be annotated: \( \epsilon_1 = \langle \text{She}, \text{POET} \rangle; \epsilon_2 = \langle \text{published}, \text{PUBLISH} \rangle, \) and \( \epsilon_3 = \langle \text{poetry}, \text{POEM} \rangle. \) A link structure triple connect \( \epsilon_1 \) and \( \epsilon_2, \) assigning to the former the role of agent: \( L_1 = \langle \epsilon_1, \epsilon_1, \text{Agent} \rangle. \)

Frameworks for the annotation of events are heterogeneous, reflecting the high variety of existing event extraction tasks (see [Xiang and Wang (2019)]). The ACE/ERE initiative ([Song et al. 2015]) resulted in a series of news corpora in which textual triggers were annotated and labelled by referring to a close set of event types. For instance, the word ‘migration’ triggers an event of the type ‘Movement’. The Topic Detection and Tracking initiative (TDT) ([Allan, 2012]) led to a corpus in which the story rather is annotated and labelled with reference to actual historical events (eg: Death of Kim Jong II, Cuban Riot in Panama, etc.) rather than general categories. The ISO-TimeML framework ([Pustejovsky et al., 2010]) is a standard for the annotation of temporal expressions, events, and temporal relations between events. According to such approach, an instance of the type ‘EVENT’ must be used to annotate a situation that happens or occurs. Furthermore, events are categorized by some linguistic properties. For instance, the word ‘start’ triggers an event of the type ‘ASPECTUAL’, whereas ‘say’ is a ‘REPORTING’ event. The Richer Event Description (RED) guidelines ([O’Gorman et al., 2016]) is a reformulation of ISO-TimeML in which the taxonomy of event properties is simplified, but further annotation layers are defined: entities, causal relations between events, and link between entities.

Our annotation guidelines for biographies take inspiration from two existing frameworks. On one side, they adopt the semantic formalism of SemAF ([Bunt and Palmer, 2013]), while on the other side they partly inherit the taxonomy of events proposed in ISO-TimeML ([Pustejovsky et al., 2010]).

Biographical Events Extraction. Despite the existence of several semantic models for biographical events encoding, few works focused on the extraction of biographical information. Russo et al. ([Russo et al., 2015]) collected 782 biographies of people deported to Nazi concentration camps with the aim of extracting a predefined set of information from both raw text and DBpedia. Then, all information was arranged into a structured representation by using the TimeML framework ([Pustejovsky et al., 2010]). Menini et al. ([2017]) defined a set of verbal motion frames and used it to extract migration events from Wikipedia biographies. Both works adopt a top-down approach. First, a number of information to be retrieved is defined, then an event extraction pipeline is built.

Our guidelines rely on a bottom-up approach: instead of a predetermined classification of event types to be extracted, the focus is on all events in which the entity of the type writer is involved as a participant.

3. Data Collection and Annotation Scheme Design

In this section, the data gathering and preprocessing from Wikipedia is described; then, the annotation guidelines are presented.

3.1. Data Gathering

The corpus is a collection of sentences extracted from 8,047 Wikipedia English pages of under-represented writer, namely authors born in non-Western countries, migrants or ethnic minorities. Specifically, Wikidata properties ‘place of birth’, ‘occupation’, and ‘ethnic group’ were exploited in order to identify all writers born in a former colony or writers belonging to a minority group that were born in a Western country. The data gathering process was performed in four steps: (i) each biography was split in sentences using Stanford Core NLP ([Manning et al., 2014]); (ii) for each sentence, all the named entities of the type Location or Organization were identified using the same tool; (iii) an automatic semantic role labelling was performed on each sentence, using SRL Bert ([Shi and Lin, 2019]). The resulting dataset of 218,198 tuples of predicates and semantic arguments contains at least one Location or one Organization. Below some examples are reported:

- \text{predicate}: \text{move}, \text{ARG2}: \text{to New York City};
- \text{predicate}: \text{study}, \text{ARGM-LOC}: \text{in the Convent of Jesus and Mary School in New Delhi};
- \text{predicate}: \text{confere}, \text{ARG0}: \text{by the municipality of Kautokeino and the Kautokeino Sámi Association}.

In the final step (iv), we identified the most frequently occurring combinations of ‘predicate,ARG0’, ‘predicate,ARG1’, and ‘predicate,ARG2’ in order to select a sample representative of the sentences in the data set for annotation.

3.2. Annotation Guidelines

Annotation guidelines were developed in order to annotate all events in which the subject of the biography is a participant in the event. It is important to notice that there is no one-to-one correspondence between a tuple of the type \langle \text{predicate,argument}\rangle and a sentence, since most sentences contain more than one predicate, as it can be observed in the following example: “In 1974 he left South Africa, living in North America, Europe and the Middle East, before returning in 1986”. Hence, a separate annotation for each relevant subject-predicate pair was made.

The selection of the most significant semantic arguments in biographical events is guided by previous work ([Stranisci et al., 2021]) in which a set of combinations of life events and named entities types were
recognized as salient for biographies: locations for migrations; organizations for education and career events. Therefore, our guidelines mainly focus on events in which the subject of the biography is involved with such named entities. Moreover, since time is a crucial feature for biographical narratives, guidelines include the identification of temporal expressions.

**Identification of the entity and their semantic role.**
The prerequisite for an event to be annotated was that it had to involve the biography subject. This involvement was not always direct, though: an author could be mentioned through their works, as in “Her third novel, Missing in Machu Picchu (2013), was awarded,” or through a group they were part of, as in “At the age of nine, her family moved to Ghana”. According to the RED guidelines, the former case was a BRIDGING relation, while the latter was a SET-MEMBER link. In our guidelines all these types of entity had to be annotated as if they were an instance of the writer, in order to consider important biographical events of the type ‘his book win a prize’, in which the writer is only indirectly mentioned.

Together with the identification of the writer, annotators had to specify her/his semantic role, in order to classify their participation in the event. Two labels were created for this purpose, both inspired by the Propbank framework: ‘writer-ARG0’, when the entity plays roles covered by this argument, such as ‘Agent’ or ‘Perceiver’, ‘writer-ARGx’, if they play roles covered by other argument types, like ‘Patience’. Even though grouping such arguments slightly reduces the expressiveness of the PropBank framework, it has the advantage of helping the annotators to focus on a more general distinction between events in which writers have an active role and events in which they have not.

**Identification of events, and their taxonomy.**
Events had to be annotated according to the TimeML scheme and were categorized according to a subset of TimeML event types tag: ‘ASP-EVENT’ to mark all verbs conveying aspectual information, and ‘REP-EVENT’, for verbs reporting other states and events, ‘STATE’, ‘EVENT’ respectively. The last two are mutually exclusive in each annotation. For instance, in the sentence “Then, she traveled to Venezuela, where she worked in linguistics at the Department of Justice of Venezuela” two separate annotations had to be provided: one for the pair ‘she-traveled’, and another one for the pair ‘she-worked’. ‘ASP-EVENT’ and ‘REP-EVENT’ may occur jointly with another ‘STATE’ or ‘EVENT’, in expressions such as ‘he started working’, which results in the link structure < started, working, ASP > and ‘he said he moved’, which is encoded as < said, moved, REP >.

Since some sentences contained nominal utterances and there were semantically empty verbs like the copular be, guidelines allowed for the annotation of names as events or states in subordinate clauses like “After a brief time in Toronto”, or in nominal predicates such “He was a professor”. The annotation of nominal events was supported by NomBank frames [Meyers et al., 2004].

**Identification of arguments containing a location or an organization.**
The third component of the guidelines was aimed at identifying the relation between the writer and some named entities that may signal their migration or their condition of being a migrant in a given place. Annotators were asked to select the entire argument containing a location or an organization, and to mark the latter as ‘ARGx-ORG’, and the former ‘ARGx-LOC’. The focus of this annotation stage was not to identify the specific semantic argument, but to label the cases in which a named entity is part of a semantic role. This allowed to refine clusters of arguments and map them onto existing taxonomies. For instance, in ‘He works for Sorganization’, the ARGx-ORG may be mapped onto the VerbNet ‘Beneficiary’ thematic role.

**Identification of temporal arguments.** Finally, the guidelines establish the annotation of temporal arguments. Rather than identifying only the token triggering a time expression, the entire argument had to be selected and labelled as ‘ARGM-TIME’. For instance, in the example “In 1974 he left South Africa” the entire semantic argument “in 1974” had to be annotated.

A fully annotated example of the sentence below is the following:

“In 1974 he left South Africa, living in North America, Europe and the Middle East, before returning in 1986”.

\[
\begin{align*}
\epsilon_1 &= \text{<he, WRITER>} \\
\epsilon_2 &= \text{<left, LEAVE>} \\
\epsilon_3 &= \text{<South Africa, LOCATION>} \\
\epsilon_4 &= \text{<living, LIVE>} \\
\epsilon_5 &= \text{<in South Africa, LOCATION>} \\
\epsilon_6 &= \text{<in 1974, TIME>} \\
L_1 &= \text{<\epsilon_1, \epsilon_2, writer-ARG0>} \\
L_2 &= \text{<\epsilon_3, \epsilon_2, ARGx-LOC>} \\
L_3 &= \text{<\epsilon_1, \epsilon_4, writer-ARG0>} \\
L_4 &= \text{<\epsilon_5, \epsilon_4, ARGx-LOC>} \\
L_5 &= \text{<\epsilon_6, \epsilon_2, ARGM-TIME>} 
\end{align*}
\]

4. Annotation Task and Results

The annotation task involved 4 annotators who evaluated 1,000 sentences sampled from 8,047 Wikipedia English pages of under-represented writers. One of them (ann_01 in Table 2) evaluated all sentences 1000, while the others annotated respectively 200 (ann_02), 100 (ann_03), and 200 (ann_04) sentences. The annotation has been performed on Label Studio™, an Open Source platform that easily allows to organize chunk annotation tasks. Annotators were asked to provide one

[1] https://github.com/timjogorman/RicherEventDescription
[2] https://labelstud.io/
separate annotation for every EVENT or STATE identified in each sentence. As it is shown in Figure 1, the same sentence has received two separated annotations. The first is the chunk ‘jailed’, labelled as an EVENT, the second is the chunk ‘detained’, labelled as a STATE.

Table 1: Inter-Annotator Agreement (F-measure).

| annotation           | Event | State | Writer-ARG0 | Writer-ARGx | ARGx-LOC | ARGx-ORG | ARGx-TIME |
|----------------------|-------|-------|-------------|-------------|----------|----------|-----------|
| ann_01 (baseline ann_02) | 0.83  | 0.72  | 0.90        | 0.87        | 0.78     | 0.75     | 0.91      |
| ann_01 (baseline ann_03) | 0.83  | 0.76  | 0.91        | 0.92        | 0.38     | 0.75     | 0.94      |
| ann_01 (baseline ann_04) | 0.84  | 0.66  | 0.91        | 0.90        | 0.65     | 0.83     | 0.85      |
| ann_02 (baseline ann_05) | 0.83  | 0.66  | 0.91        | 0.89        | 0.85     | 0.94     | 0.94      |
| ann_03 (baseline ann_01) | 0.82  | 0.64  | 0.93        | 0.95        | 0.91     | 0.92     | 0.94      |
| ann_04 (baseline ann_01) | 0.84  | 0.61  | 0.91        | 0.89        | 0.75     | 0.70     | 0.87      |
| Average              | 0.83  | 0.67  | 0.91        | 0.90        | 0.75     | 0.81     | 0.91      |

In Table 2 the 10 most frequently occurring events and states are shown. Some of them are related to the writers’ educational journey (eg: graduate, hold, attend, study), others to their career (eg: publish, serve, teach, win, work, write). Finally, there is a set of events framing personal events (eg: bear, die, live, move). From such clusters of predicates, a set of biographical frames may be derived. This is the inverse process of existing works on biographical knowledge extraction from text (Menini et al., 2017; Russo et al., 2015). Rather than selecting a prior number of frames to be used for data gathering, this approach extracts knowledge that must subsequently be aligned to existing resources.

5. Mapping

The annotation guidelines and the corpus presented in this paper constitute a first, yet essential step towards the development of a system for the automatic extraction of biographical events. While such system will be addressed in future work, in this Section we illustrate...
how the current corpus could be extended to obtain an appropriate training dataset. We show how the data from OntoNotes (Hovy et al., 2006) can be mapped onto our annotation schema, and report some figures regarding this process. Although OntoNotes was selected as the first target for this mapping, the same process could also be applied to other PropBank-like datasets, such as (Kim and Klinger, 2018), for the enrichment of our original corpus.

OntoNotes (Hovy et al., 2006) contains a multi-layer annotation of texts from several domains (e.g., newswires, magazine articles, broadcast news). For each such domain, a PropBank-based semantic annotation and the annotation of named entities is provided. The data set is composed of 99,974 sentences, 249,157 rolesets, and 554,307 semantic arguments. Given a verb, rolesets represent all roles possibly associated to each of its senses according to the PropBank model (Bonial et al., 2014).

In order to align the two corpora, we extracted all verb occurrences and their arguments. Then, we computed the percentage of arguments containing a named entity of the type ORG, GPE, or PERSON. Table 4 shows the 8 most frequently recurring instances for the roleset associated to work.01, which expresses the sense “work, being employed, acts, deeds”. As it can be observed, in some of them there is a predominance of GPE and ORG compared to entities of the type PERSON. This enables the identification of some arguments that are more likely to be aligned with our corpus: it is the case of ARG1 and ARG2, which respectively correspond to ‘job, project’ and ‘employer, benefactive’. Let us consider the following examples.

5. <work, to improve China’s nickel industry’s level of technology, technique and equipment, ARG1>
6. <work, for the Justice Department, ARG2>

In the former case, the GPE simply adds information about the argument, as in 5). In the latter case, it is directly linked to the verb with the role of ‘benefactive’, as in 6).

We analyzed the distribution for the 10 most frequently occurring events and states in our corpus (Table 5): they amount to 430 events, covering the 27% of the overall number of instances. Besides the widespread presence of the ARGM-LOC modifier, some patterns emerge. There is a set of events in which an ORG or a GPE has agency on the event: publish.01, award.01. The 60% of the ARG0 linked to publish.01 and the 80% linked to award.01 contain a GPE or a ORG. In fact, many books are published and many prizes are awarded by an organization or a geopolitical entity. Other patterns may imply the ‘benefactive’ role: as mentioned before, work.01 is often linked to a bene-

Table 3: The ten most frequent events and states within the corpus.

| Event | occ. | State | occ. |
|-------|------|-------|------|
| receive | 56 | work | 60 |
| publish | 39 | write | 46 |
| win | 36 | study | 41 |
| award | 34 | teach | 28 |
| write | 25 | attend | 28 |
| move | 25 | live | 21 |
| bear | 22 | serve | 20 |
| graduate | 21 | hold | 15 |
| take | 20 | spend | 14 |
| die | 20 | writer | 13 |

Table 4: The distribution of arguments containing a Organization (ORG), a Person, or a Geo Political Entity (GPE) for the work.01 PropBank sense in OntoNotes.

| argument | n. | ORG | PERSON | GPE |
|----------|----|-----|--------|-----|
| ARG0 | 996 | 6.0% | 8.1% | 3.5% |
| ARG1 | 347 | 7.8% | 2.0% | 7.2% |
| ARGM-LOC | 248 | 7.7% | 0.4% | 18.5% |
| ARGM-MNR | 239 | 0.4% | 0.8% | 0.0% |
| ARGM-TMP | 148 | 1.4% | 1.4% | 0% |
| ARGM-DIS | 122 | 0.8% | 3.3% | 0.0% |
| ARG2 | 107 | 29.0% | 8.4% | 11.2% |
| ARG3 | 99 | 17.2% | 13.1% | 8.1% |
Table 5: The most recurring link structures of the type \verb<verb,argument containing ORG or GPE> for the 10 events and states with more occurrences in our corpus.

| verb   | argument(s) | description |
|--------|-------------|-------------|
| work.01 | ARG2 ARG1   | beneactive project |
| write.01 | ARG2        | beneactive   |
| receive.01 | ARG2        | received from |
| publish.01 | ARG0        | publisher    |
| win.01   | ARG1        | prize        |
| award.01 | ARG0, ARG2  | giver, beneficiary |
| attend.01 | ARG1        | thing attended |
| move.01  | ARG2        | destination  |
| move.02  | ARG1        | measures     |
| study.01 | ARGM-LOC    | location     |
| teach.01 | ARGM-LOC    | location     |

6. Conclusions and Future Work

In this paper we presented a novel schema for the annotation of biographical events in free text. We have also built a new corpus for this task, containing 1,000 annotated sentences sampled from 8,047 Wikipedia English pages pertaining underrepresented writers. Finally, we have shown how existing resources, such as OntoNotes, can be mapped onto our annotation schema in order to increase significantly the size of the corpus. The developed corpus and the proposed schema are preparatory for the development of an automatic system for the extraction of biographical events from free text, which constitutes the main focus of our future work. Ideally, we could start from existing systems performing semantic role labeling (such as \cite{Shi and Lin, 2019}), and then adapt the results in a manner similar to the one adopted in the mapping process. The mapping process itself also needs to be strengthened with a more thorough evaluation and with the development of specific rules to better detect the entities filling the arguments. Our final focus consists in a study aimed at better understanding and quantifying how the biographical information extracted by the system can be beneficial to tackle other downstream tasks.

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