SentiML++: An Extension of the SentiML Sentiment Annotation Scheme

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Abstract. In this paper, we propose *SentiML++*, an extension of SentiML with a focus on annotating opinions answering aspects of the general question "who has what opinion about whom in which context?". A detailed comparison with SentiML and other existing annotation schemes is also presented. The data collection annotated with SentiML has also been annotated with *SentiML++* and is available for download for research purpose.

1 Introduction

The semantic annotation of opinions is one of the very important tasks of opinion mining. Semantic annotations are very important both for training machine learning approaches and for evaluating opinion mining methods. Unfortunately, there have been hardly any serious proposal attempts of appropriate annotation schemas until recently when SentiML [2], OpinionMiningML [9] and EmotionML [10] were proposed. In this paper, we discuss, compare and identify the positives and negatives of these annotation schemes. Following this overview, we propose SentiML++, an extension of SentiML that addresses several shortcomings of the state of the art.

SentiML. The SentiML annotation schema [2] follows a conventional sentiment annotation style and is based on Appraisal Framework (AF) [5] which is a strong linguistically-grounded theory. AF helps to define appraisal types (affect, judgments and appreciation) within the modifier tag which is another positive point to be noted in SentiML. With a very simple annotation scheme, SentiML is popular because adopting its annotation scheme does not require to acquire any specific skills. However, concerns can be raised about SentiML.

OpinionMiningML. OpinionMiningML [9] is an XML-based formalism that allows tagging of attitude expressions for features or objects as found in a textual segment. It targets extraction of feature-based opinion expressions but its scope is limited to proposing an annotation schema. Besides this, the structure of OpinionMiningML is not straightforward and can be threatened by challenges

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for feature and relation extraction while developing an automatic tagger for this annotation scheme.

EmotionML. EmotionML [10] aims to make concepts from major emotion theories available in a broad range of technological contexts. Being informed by the effective sciences, EmotionML recognises the fact that there is no single agreed representation of effective states, nor of vocabularies to use. Therefore, an emotional state $<emotion>$ can be characterised using four types of descriptions: $<category>, <dimension>, <appraisal>$ and $<action - tendency>$. Furthermore, the vocabulary used can be identified.

SentiML Example. Throughout the article, we will use the following sentence as a running example: *"The U.S. State Department on Tuesday (KST) rated the human rights situation in North Korea "poor" in its annual human rights report, casting dark clouds on the already tense relationship between Pyongyang and Washington."* Relevant annotations in *SentiML* are given below:

```
<APPRAISALGROUP id="A0" fromID="T0" fromText="situation" toID="M0"
toText="poor" orientation="negative"/>
<APPRAISALGROUP id="A1" fromID="M1" fromText="dark" toID="T1" toText="clouds
      " orientation="negative"/>
<APPRAISALGROUP id="A2" fromID="M2" fromText="tense" toID="T2" toText="
      relationship" orientation="negative"/>
<MODIFIER id="M0" start="201" end="205" text="poor" attitude="appreciation"
      orientation="negative" force="normal" polarity="unmarked"/>
<MODIFIER id="M1" start="250" end="254" text="dark" attitude="appreciation"
      orientation="negative" force="normal" polarity="unmarked"/>
<MODIFIER id="M2" start="277" end="282" text="tense" attitude="appreciation"
      orientation="negative" force="normal" polarity="unmarked"/>
<TARGET id="T0" start="175" end="184" text="situation" type="thing" orientation="
      neutral"/>
<TARGET id="T1" start="255" end="261" text="clouds" type="thing" orientation="
      ambiguous"/>
<TARGET id="T2" start="283" end="295" text="relationship" type="thing" orientation="
      neutral"/>
```

OpinionMiningML example below annotated using the *OpinionMiningML* syntax:

```
<COMMENT id="1" ontologyreference="1">
<FRAGMENT id="1"> The U.S. State Department on Tuesday (KST) rated the human
      rights situation in North Korea "poor" </FRAGMENT>
<FRAGMENT id="2"> in its annual human rights report, casting dark clouds on the already
      tense relationship between Pyongyang and Washington.</FRAGMENT>
<APPRAISAL polarity="negative" intensity="medium">
   <FACETREFERENCE>1</FACETREFERENCE>
   <FRAGMENTREFERENCE>1</FRAGMENTREFERENCE>
   <FRAGMENTREFERENCE>2</FRAGMENTREFERENCE>
</APPRAISAL>
<APPRAISAL polarity="negative" intensity="medium">
   <FACETREFERENCE>2</FACETREFERENCE>
   <FRAGMENTREFERENCE>1</FRAGMENTREFERENCE>
   <FRAGMENTREFERENCE>2</FRAGMENTREFERENCE>
</APPRAISAL>
</COMMENT>
```

EmotionML example presented hereby an example annotated using the EmotionML syntax:

```
<emotionml xmlns="http://www.w3.org/2009/10/emotionml"
xmlns:meta="http://www.example.com/metadata"
category−set="http://www.w3.org/TR/emotion−voc/xml#occ−categories">
<info>  <meta:doc>Example taken from annotation of SentiML </meta:doc> </info>
The U.S. State Department on Tuesday (KST)
<emotion> < category  name="reproach"/>
   rated the human rights situation in North Korea "poor" </emotion> in its annual human
      rights report
<emotion>  <category name="disappointment"/>
   casting dark clouds </emotion>
 on the already <emotion>
   <category  name="disappointment"/>
   tense relationship between Pyongyang and Washington.
</emotion>
</emotionML>
```

2 Comparison

In this section we give a comparison of annotations schemes from different perspectives, summarized in Table 1. From this comparison, it can be concluded that SentiML has a larger scope and it is equipped with a more affordable vocabulary with respect to the previous work [1,4,6,8]. Hence, we find it the most suitable choice for our current work.

3 SentiML++

In this section, we provide an extension of *SentiML* considering the work of *Bing Liu* [3] as a reference and find out that most of the aspects defining an opinion seem to be missing (completely or partially). For example, *SentiML* works on sub-sentence level and hence leaves actual holder and target entities of sentiment of a sentence unmarked. As far as opinion orientation is concerned, it deals with prior polarities in a better way than the contextual ambiguities. It does not recognize the topic of a sentence, hence fails to identify topic-based contextual ambiguities. Similarly, the contexts defined by cultural phrases and emoticons cannot be identified using *SentiML*. Flexibility and completeness are important characteristics of an annotation scheme [7] and unfortunately, *SentiML* fails to have both of these characteristics. Identification of opinion words and their polarity with respect to a given topic could help resolving contextual ambiguities. Therefore, we propose to take topic identification into account in SentiML++ by proposing <TOPIC> element. A good share of the opinions generally found on the web are expressed informally. This includes the use of emoticons and sarcastic phrases or cultural expressions (e.g., "bored to death", "dressed to kill", etc.) that could invert the semantics of the text surrounding them. Identification of such contexts could aid the automated detection of such opinion inversions. In SentiML++, we deal with this problem using <INFORMAL> element.

Table 1. Comparison of annotation schemes

Scope	EmotionML, the W3C standard, is an effort to cover all aspects of emotions globally in all concerned fields while OpinionMiningML and SentiML limit themselves to domains of IR and NLP. In our view, SentiML has larger scope as compared to OpinionMiningML which limits itself only to feature-based sentiment analysis
Complexity	Because of its larger scope than the other two annotation schemes, EmotionML can be considered complex and less user-friendly. SentiML is much easier to use than OpinionMiningML because of the vocabulary of its annotation scheme which matches the vocabulary used in research work of this field (i.e. concepts like holder, target, modifier, etc.)
Vocabulary	EmotionML text annotation is equipped with new and broader vocabulary while targets of SentiML and OpinionMiningML are more specific. SentiML revolves around the concept of modifier and targets of the sentiments while OpinionMiningML's focus remains on sentiment relevant to features of the objects and equips itself with numerous meta-tags
Structure	The structure of all three annotation schemes follow XML based format but OpinionMiningML defines granularity better than the other annotation schemes by reaching up to the feature level
Contextual ambiguities	While all three annotation schemes focus on defining semantics of the expression types, such as appreciation, suggestion etc., SentiML also tackles the issue of contextual ambiguities which is a big research challenge in the field of opinion mining
Theoretical grounds	EmotionML is a W3C standard and has been recommended after years of discussion and debate between experts and stakeholders while SentiML is based on the Appraisal Framework, a strong linguistically-grounded theory. OpinionMiningML, in the contrary, has not been reported to have a theoretical basis
Granularity level	Another distinction that can be observed while comparing these annotation schemes is their granularity level. EmotionML is found to be operating on the sentence level while OpinionMiningML and SentiML are rather focusing on sub-sentence levels. While it is mandatory to analyze on a sub-sentence (or word level) to find correct sentiments, the sentence is however a more logical unit of discourse
Completeness	Completeness [7] is one of the most important features of annotation schemes. Completeness demands whether an annotation deals with all or most of the real world scenarios. Observing all of these annotations i.e. SentiML, EmotionML and OpinionMiningML in light of this particular characteristic, no annotation scheme seems to satisfy it. SentiML and EmotionML behave similarly by just annotating sentimental expressions while OpinionMiningML goes a step forward by targeting features of objects but fails to deal with contextual aspects of opinions, one of the major problems of opinion mining
Flexibility	EmotionML, knowing the challenges of different domains, gives freedom to use whatever vocabulary of emotional states suited to a particular domain. OpinionMiningML follows EmotionML in this regard and gives the choice of building a domain-based ontology as required, a possibility that SentiML lacks

SentiML++ Example. SentiML++ operates on both levels i.e. phrase as well as sentence level. In this section, we annotate the same sentence as an example using SentiML++. The annotation includes the introduction of sentence-level markups like <HOLDER>, <TARGET>, <ORIENTATION>, <TOPIC> and <INFORMAL> while only <HOLDER> is introduced on the sub-sentence level. All of these markups come under the main markup of <SENTENCE> while sub-sentence level annotation comes under <PHRASES>. The markup <SENTENCE> includes one attribute called "type" with possible values "general" or "informal". The value "general" is used for ordinary sentences while the value "informal" is only used when the whole identified sentence is an idiom, a metaphor or an emoticon. When the value "informal" is used, only the <INFORMAL> markup plays its role while other markups are discarded because they are rendered meaningless. The <HOLDER> markup was introduced on the sub-sentence level to identify the holders even at this smaller granularity, if needed.

```
<SENTENCE ID=0 type="general">
  <HOLDER id="H0" start="33" end="53" text="U.S. State Department" type="organization"
    orientation="neutral"/>
  <TARGET id="T0" start="108" end="117" text="North Korea" type="country" orientation="
    neutral"/>
  <ORIENTATION polarity="negative">
  <TOPIC id="1" ref="www.dmoz.org" chain="Society:Issues:Human Rights and Liberties">
  <PHRASES>
  <APPRAISALGROUP id="A0" fromID="T0" fromText="situation" toID="M0" toText="poor"
    Holder="H0" orientation="negative"/>
  <APPRAISALGROUP id="A1" fromID="M1" fromText="dark" toID="T1" toText="clouds"
    Holder="H1" orientation="negative"/>
  <APPRAISALGROUP id="A2" fromID="M2" fromText="tense" toID="T2" toText="relationship
    " Holder="H2" orientation="negative"/>
  <MODIFIER id="M0" start="201" end="205" text="poor" attitude="appreciation" orientation=
    "negative" force="normal" polarity="unmarked"/>
  <MODIFIER id="M1" start="250" end="254" text="dark" attitude="appreciation" orientation="
    negative" force="normal" polarity="unmarked"/>
  <MODIFIER id="M2" start="277" end="282" text="tense" attitude="appreciation" orientation=
    "negative" force="normal" polarity="unmarked"/>
  <TARGET id="T1" start="175" end="184" text="situation" type="thing" orientation="neutral"
    />
  <TARGET id="T2" start="255" end="261" text="clouds" type="thing" orientation="ambiguous
    "/>
  <TARGET id="T3" start="283" end="295" text="relationship" type="thing" orientation="
    neutral"/>
  <HOLDER id="H1" start="33" end="53" text="U.S. State Department" type="organization"
    orientation="neutral"/>
  <HOLDER id="H2" start="33" end="53" text="U.S. State Department" type="organization"
    orientation="neutral"/>
  <HOLDER id="H3" start="33" end="53" text="U.S. State Department" type="organization"
    orientation="neutral"/>
   </PHRASES>
</SENTENCE>
```

It must be noted that <APPRAISALGROUP> in SentiML++ links modifier, target and holder identified at the sub-sentence level. This is in contradiction with SentiML [2], where only modifier and target are linked. <Holder> and <Target> elements are found on both levels i.e. sentence and sub-sentence level. Natural language processing techniques such as syntactic parsing can be helpful in identifying these elements on both granularity levels.

4 Conclusions and Future Work

In this paper, we proposed *SentiML++*, an extension of SentiML. We proposed to add target (on sentence level), holder, topic and informal sentence identification as part of *SentiML++*. *SentiML++* adds flexibility to SentiML by giving freedom of choice for a taxonomy when annotating the topic of a sentence. As part of our future work, we plan to further enhance SentiML++ by modeling relations between its elements. The idea is to propose a more suitable model for the semantic web so that state-of-the-art semantic web tools can be leveraged to exploit its semantics.

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