AUTOMATIC REFLECTIVE WRITING ANALYSIS BASED ON SEMANTIC CONCEPTS

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ABSTRACT

This study proposes a semantic-based approach for reflective writing analysis to overcome the limitations of existing shallow processing approaches. The semantic analysis examines the meaning of linguistic input that depends mainly on transferring words, phrases and sentences into concepts in knowledge sources, such as WordNet-Affect and analysing the relationships of mapped concepts in the underlying knowledge sources. The proposed reflective writing analysis approach focuses on the efficiency of using affectional and emotional concepts identified in WordNet-Affect to classify text into reflective or non-reflective.

KEYWORDS

WordNet-Affect, Classification, Reflective, Semantic-Based

1. PROBLEM STATEMENT

Reflective writing (RW) involves insight into and mental consideration of learned topics, past experiences and actions. RW has several definitions in the literature – for example, it is defined as a form of conceptual processing with a purpose applied to unstructured ideas in a case with an unobvious solution (Moon, 1999). The considerable effort required to analyse reflective writing has stimulated the need for automatic analysis (Corich, 2011). The problems of existing automatic reflection analysis include the inability to deal with the depth of reflection activities in the text (Ullmann, 2011) because the existing approach depends on the strings alone and ignores the semantic features of the text.

2. SEMANTIC-BASED REFLECTIVE WRITING ANALYSIS

The proposed approach for RW analysis depends on classifying each sentence based on its feature vector constructed with reference to a group of affectional and emotional concepts identified in WordNet-Affect. WordNet-Affect is a lexical resource created in a semi-automatic way by augmenting WordNet with effective labels. Synsets, which a set of words can be regarded as synonyms, in WordNet have each been annotated with one semantic affective label. In particular, the effective concepts representing emotional state are individuated by synsets marked with the A-label “emotion”. There are also other a-labels for those concepts representing moods, situations eliciting emotions, or emotional responses. The feature vector contains a set of features that correspond to the identified concepts in WordNet-Affect. These features are emotion, mood, trait, cognitive and physical state, hedonic signal, emotion-eliciting situation, emotional response, behaviour, attitude and sensation. The proposed approach is illustrated in Figure 1.

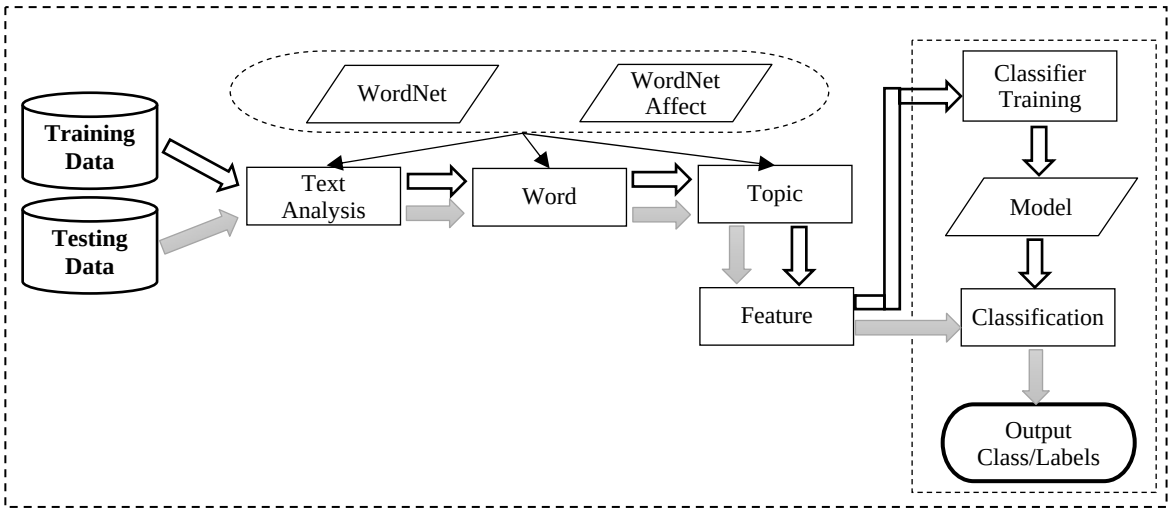

Figure. 1. Semantic-based reflective writing analysis approach

Firstly, the process is commenced by analysing the text and then mapping it to the corresponding concept in WordNet-Affect. Secondly, the word sense is disambiguated. The topic of the text is then modelled with reference to WordNet-Affect. A feature vector of WordNet-Affect concepts is constructed, and the semantic distance between the input sentence and each concept is calculated. Finally, with the use of SVM classification algorithms, the feature vector is used to classify the input text into reflective or non-reflective categories.

Instead of using direct mapping into WordNet-Affect, these synsets are used to model the topic of the text. As reflective analysis depends on sentences, rather than whole text, short sentences classification cannot be implemented directly. Accordingly, each sentence is linked to all WordNet-Affects categories. As the synsets for the input text are extracted, the similarity of each synset with each category in the WordNet Affect is calculated using Lesk measure(Pedersen et al. 2004). Accordingly, each extracted synset in the input text will have a vector of values, whose length equal to the number of categories in WordNet. Given that there are multiple synsets for each category in WordNet-Affect, the similarity is calculated as the maximum similarity with any of these synsets, same in the previous stage.

3. EVALUATION

To evaluate the proposed approach for RW detection, a dataset has been constructed based on the British Academic Writing English Corpus (Heuboeck, 2010). The corpus is formed of a set of student writing assignments in various fields of study, including architecture, chemistry and computer science. Each assignment is graded with M (Merit) and D (Distinction). The corpus involves 13 different assignment formats, including case study, critique and literature survey. This dataset was not created for reflection studies and does not classify the type of text as either reflective or non-reflective.

A single file from each assignment format is selected from various fields of study. Only assignments with the distinction mark ‘D’ are considered in the experiments, as illustrated in Table 1. Each assignment is divided into separate sentences, which have been manually annotated by experts as either non-reflective or reflective. Examples are presented in Table 2. The total number of sentences used in the experiments is 979. The non-reflective and reflective categories have 529 and 450 sentences respectively.

The proposed RW detection approach is compared with the string-based approach, which is derived from the set of keywords listed and experimented by Ullmann (2015). The string-based approach depends on string indicators and uses matching processes to flag sections of text containing reflective material. The results of the proposed approach and the string-based approach are summarised in Table 3. The results of the proposed approach slightly outperform those of the string-based approach. Aside from possessing accuracy, the proposed approach can be extended to analyse the content because it is based on semantic concepts.

Table 1. Description of the constructed dataset

Format	Field	Language	Mark	# Sentences
Case Study	Engineering	English	D	42
Critique	Computer Science	English	D	105
Design Specification	Computer Science	English	D	115
Empathy Writing	Engineering	English	D	39
Essay	Economics	English	D	100
Exercise	Computer Science	English	D	64
Explanation	Engineering	English	D	49
Literature Survey	Philosophy	English	D	20
Methodology Recount	Engineering	English	D	31
Narrative Recount	Engineering	English	D	44
Problem Question	Engineering	English	D	114
Proposal	Engineering	English	D	140
Research Report	Economics	English	D	116

Table 2. Example sentences in the dataset

Sentence	Category
The operating system controls the allocation of memory to programs.	**Non-Reflective**
I believe that the Spiral model of the software development process would have been better suited to the type of Information System the UKPA was looking to develop.	**Reflective**

Table 3. Reflective text detection result comparison

	RW Approach	String-based
Accuracy	0.616	0.606
Precision	0.627	0.547
Recall	0.715	0.667
F-Measure	0.668	0.664

4. CONCLUSION

This paper presents an automatic RW detection approach based on semantic concepts. The proposed approach involves mapping words into concepts and then creating a feature vector for each tested document. The feature vector is then used as input to the classification algorithm, which labels the text as either reflective or non-reflective. The concepts in WordNet-Affect are evaluated and analysed to demonstrate their effects on classification and labelling tasks. The result shows that WordNet-Affect for RW detection outperforms the string-based approach reported in the literature. Future work will be devoted to evaluating other concepts related to WordNet-Affect for RW fine classification.

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