Graph-based and Lexical-Syntactic Approaches for the Authorship Attribution Task

Notebook for PAN at CLEF 2012

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Introduction

Proposed approaches

Experimental settings and results

Conclusion
• Authorship attribution assumes unique and identifiable writeprints in text.

• The importance of finding the correct features for characterizing the signature or particular writing style of a given author is fundamental.
Lexical-syntactic approach: features

1. Phrase level features
   - Word prefixes
     - e.g. $ad \rightarrow \{\text{advance, adjunct, adulterate}\}$
   - Word suffixes
     - e.g. $est \rightarrow \{\text{finest, toughest, biggest}\}$
   - Stopwords
     - e.g. $\{\text{and, the, but, did}\}$
   - Trigrams of PoS
     - e.g. $\text{she:PRP drove:VBD a:DT silver:NN pt:NN cruiser:NN}$
       $\{(\text{PRP, VBD, DT}), (\text{VBD, DT, NN}), (\text{DT, NN, NN}), (\text{NN, NN, NN})\}$

2. Character level features
   - Vowel combination
     - e.g. $\text{influential} \rightarrow \text{iueia} \rightarrow \text{iuea}$
   - Vowel permutation
     - e.g. $\text{influential} \rightarrow \text{iueia}$
Lexical-syntactic approach: text representation

- Training stage:
  \[
  (x_1, x_2, x_3, \ldots, x_s, \ldots, y_1, y_2, y_3, \ldots, y_m, C)
  \]

  \textit{Feature 1} \hspace{1cm} \textit{Feature n}

- Testing stage:
  \[
  (x_1, x_2, x_3, \ldots, x_s, \ldots, y_1, y_2, y_3, \ldots, y_m)
  \]

  \textit{Feature 1} \hspace{1cm} \textit{Feature n}
Lexical-syntactic approach: Classification process
Graph-based approach: features

- In this approach, a graph based representation is considered.
- Each text paragraph is tagged with its corresponding PoS tags with the TreeTagger tool.
- Each word is stemmed using the Porter stemmer.
- In the graph representation each vertex is considered to be a stemmed word and each edge is considered to be its corresponding PoS tag.
- The word sequence of the paragraphs to be represented is kept.
- Once each paragraph is represented by means of a graph, we apply a data mining algorithm called SUBDUE in order to find the most representative words of an author.
Graph-based approach: example

- “second qualifier long road leading 1998 world cup”.
Graph-based approach: text representation

- Training stage:

\[ D = (x_1, x_2, x_3, \ldots, x_n, C) \]

*Words obtained from SUBDUE*

- Testing stage:

\[ D = (x_1, x_2, x_3, \ldots, x_n) \]

*Words obtained from SUBDUE*
Graph-based approach: Classification process
Experimental settings

- For SUBDUE we extract the 30 most representative words
- For the problems A, B, C, D, I and J we used WEKA’s implementation of SVMs
  - Kernel = polynomial mapping
- For the problems E and F, we used WEKA’s implementation K-means clustering method
  - K = 2, 3 or 4 authors
Results

Results obtained in the traditional sub-task

<table>
<thead>
<tr>
<th>Task</th>
<th>A correct/A%</th>
<th>B correct/B%</th>
<th>C correct/C%</th>
<th>D correct/D%</th>
<th>I correct/I%</th>
<th>J correct/J%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graph-based approach</td>
<td>5/83.333</td>
<td>6/60</td>
<td>5/62.5</td>
<td>4/23.529</td>
<td>8/57.142</td>
<td>13/81.25</td>
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<tr>
<td>Lexical-syntactic approach</td>
<td>4/66.666</td>
<td>3/30</td>
<td>2/25</td>
<td>6/35.294</td>
<td>10/71.428</td>
<td>7/43.75</td>
</tr>
</tbody>
</table>

Results obtained in the clustering sub-task

<table>
<thead>
<tr>
<th>Task</th>
<th>E correct/E%</th>
<th>F correct/F%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graph-based approach</td>
<td>68/75.555</td>
<td>43/53.75</td>
</tr>
<tr>
<td>Lexical-Syntactic approach</td>
<td>61/67.777</td>
<td>51/63.75</td>
</tr>
</tbody>
</table>
Concluding remarks

1 Lessons learned

- The lexical-syntactic feature approach helped to represent the writing style
- the graph-based representation obtained a better performance than the other one. However, more investigation on the graph representation is still required

2 Current work

- Other data sets and tasks
- Still more lexical-syntactic features to design and use
- Understand better the role of the Graph representation
- Experiment with different graph-based text representations that allow us to obtain much more complex patterns.
Thank you for your attention!