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

Notebook for PAN at CLEF 2012

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Traditional Authorship Attribution

- 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* $\longrightarrow$ {**ad***vance*, **ad***junct*, **ad***ulterate*}
   - **Word sufixes**
     - e.g. *est* $\longrightarrow$ {*fin***est**, *tough***est**, *bigg***est**}
   - **Stopwords**
     - e.g. {*and*, *the*, *but*, *did*}
   - **Trigrams of PoS**
     - e.g. she:PRP drove:VBD a:DT silver:NN pt:NN cruiser:NN
       $\{(PRP, VBD, DT), (VBD, DT, NN), (DT, NN, NN), (NN, NN, NN)\}$
2. Character level features
   - **Vowel combination**
     - e.g. *influential* $\longrightarrow$ *iueia* $\longrightarrow$ *iuea*
   - **Vowel permutation**
     - e.g. *influential* $\longrightarrow$ *iueia*

Lexical-syntactic approach: text representation

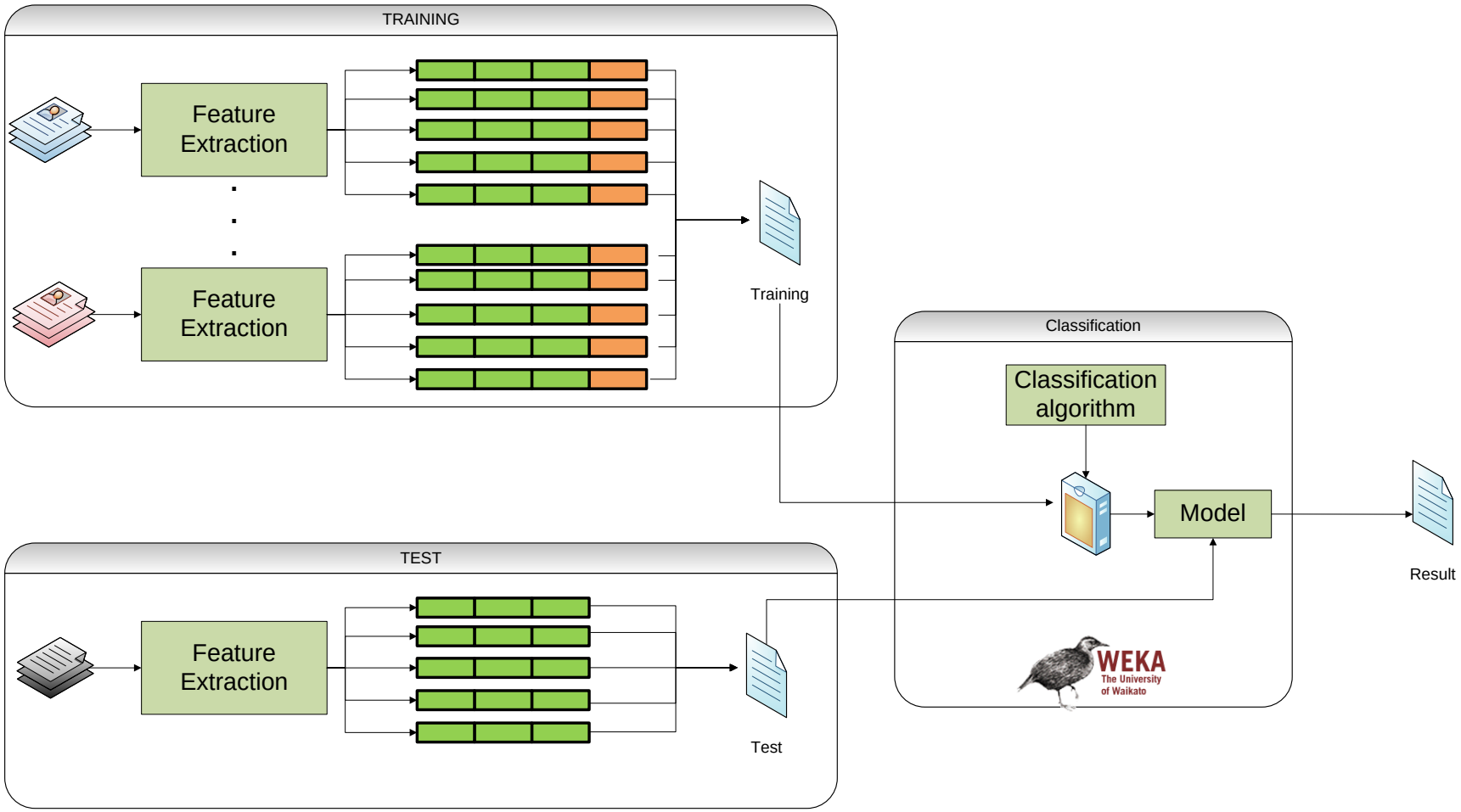
- Training stage:

$$(\underbrace{x_1, x_2, x_3, \ldots, x_s}_{Feature\ 1}, \cdots, \underbrace{y_1, y_2, y_3, \ldots, y_m}_{Feature\ n}, C)$$

- Testing stage:

$$(\underbrace{x_1, x_2, x_3, \ldots, x_s}_{Feature\ 1}, \cdots, \underbrace{y_1, y_2, y_3, \ldots, y_m}_{Feature\ n})$$

Lexical-syntactic approach: Classification process

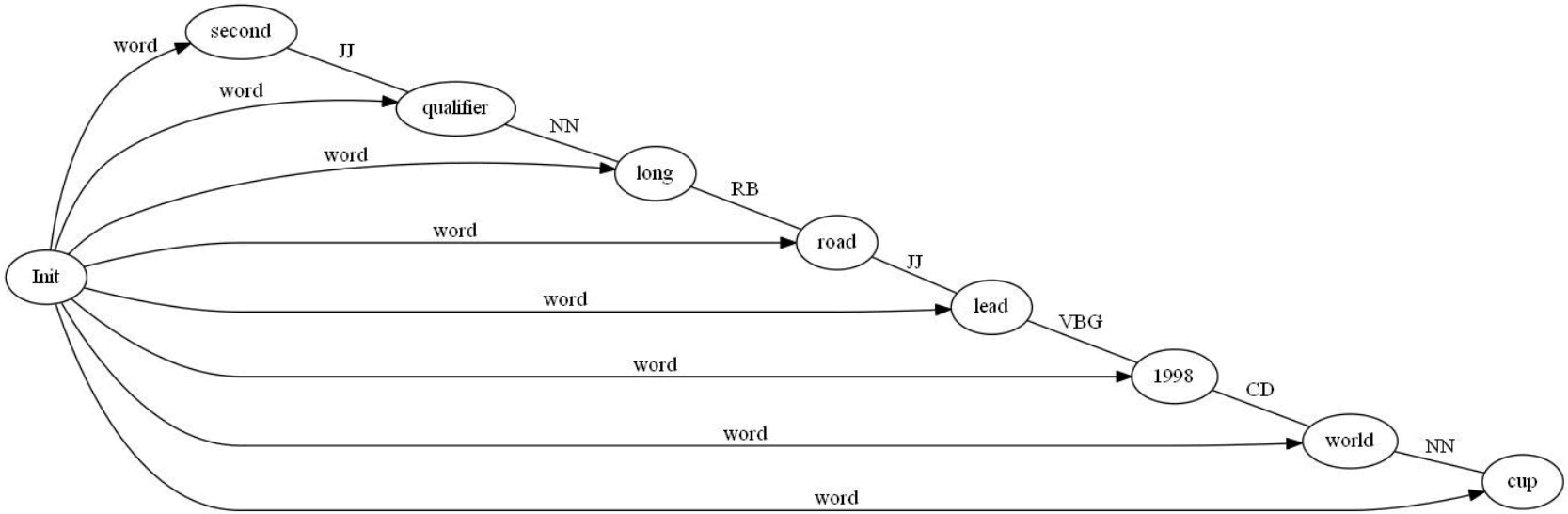


Graph-based approach: features

- 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

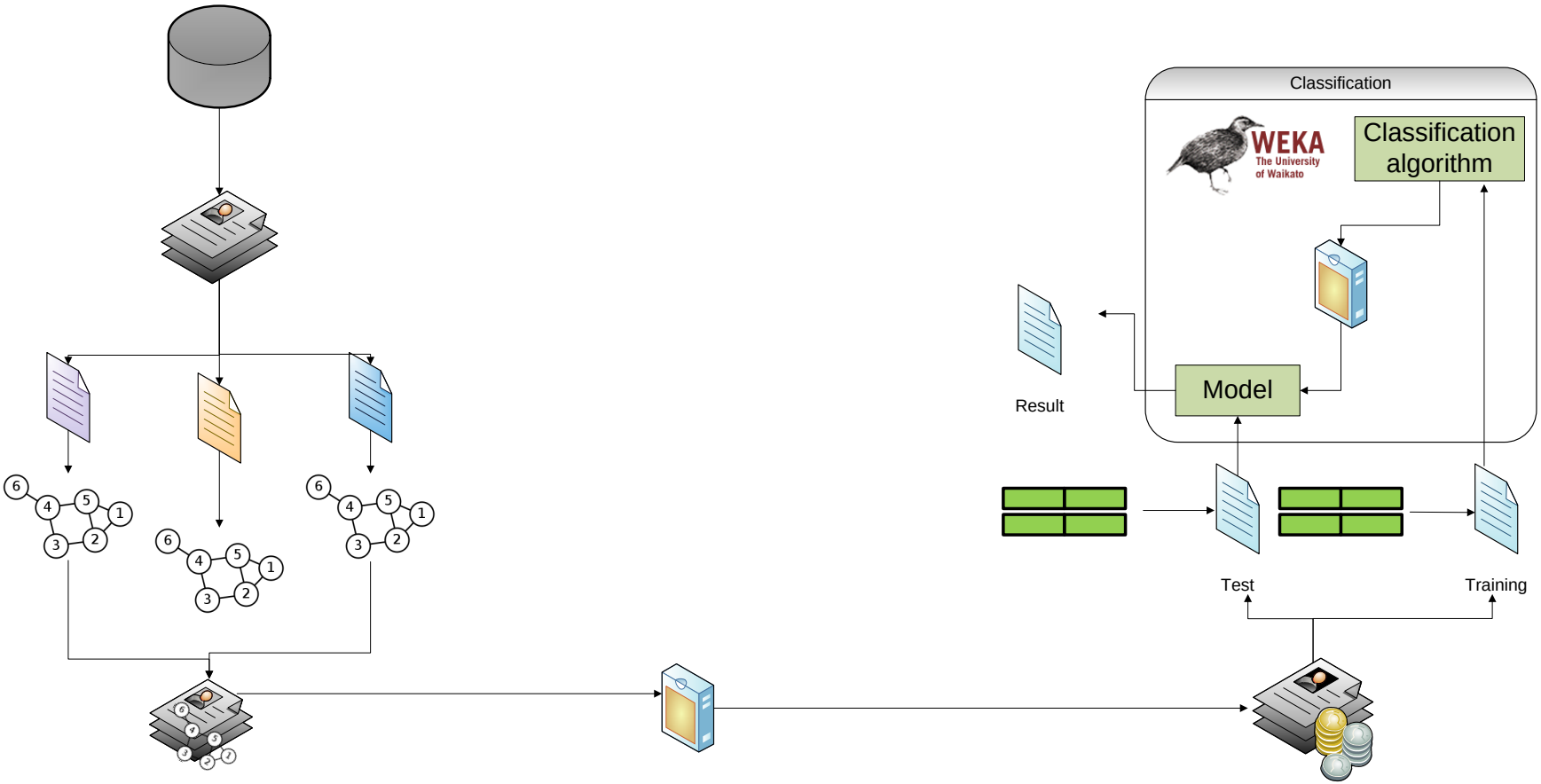
- Training stage:

$$D = (\underbrace{x_1, x_2, x_3, \ldots, x_n}_{Words\ obtained\ from\ SUBDUE}, C)$$

- Testing stage:

$$D = (\underbrace{x_1, x_2, x_3, \ldots, x_n}_{Words\ obtained\ from\ SUBDUE})$$

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
  - Kernell = 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

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

Results obtained in the clustering sub-task

Task	E correct/E%	F correct/F%
Graph-based approach	68/75.555	43/53.75
Lexical-Syntactic approach	61/67.777	51/63.75

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!