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# Linking Task: Identifying authors and book titles in verbose queries

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**Abstract.** In this paper, we present our contribution in INEX 2016 Social Book Search Track. This year, we participate in a new track called Mining track. This track focus on detecting and linking book titles in online book discussion forums. We propose a supervised approach based on Support Vector Machine (SVM) classification process combined with Conditional Random Fields (CRF) to detect book titles. Then, we use a Levenshtein distance to link books to their unique book ID.

**Keywords:** Supervised approach, Support Vector Machine, Conditional Random Fields, References detection

## 1 Introduction

The Social Book Search (SBS) Tracks [2] was introduced by INEX in 2010 with the purpose of evaluate approaches for supporting users in searching collections of books based on book metadata and associated user-generated content. Since new issues have emerged. This year, a new track is proposed called Mining Track. This track includes two tasks: classification task and linking task. As part of our work, we focused on the linking task, which consists to recognize book titles in posts and link them to their unique book ID. The goal is to identify which books are mentioned in posts. It is not necessary to identify the exact phrase that refers to book but to get the book that match the title in the collection. SBS task builds on training corpus of topics which consists of a set of 200 threads (3619 posts) labeled with touchstones<sup>1</sup>. These posts are expressed in natural language made by users of LibraryThing<sup>2</sup> forums. A data set contains book IDs, basic title and author metadata per book was provided. In addition, it is possible to use the document collection used in the Suggestion Track, which can be used as additional book metadata, consists of book descriptions for 2.8 million books. In your contribution at SBS task, we use an approach inspired by the works on the bibliographical references detection in Scholarly Publications [1]. We propose a supervised approach based on classification process combined with Conditional

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<sup>1</sup> Touchstones re

<sup>2</sup> <https://www.librarything.com/>

Random Fields (CRF) to detect book titles. Then, we use the Levenshtein distance to link books to their unique book ID.

We submit 5 runs in which we process on several variation on selected features provide by CRF, on the combination of detected tags (book titles and author names) and on the factor taken by the Levenshtein distance.

The rest of this paper is organized as follows. The following section describes our approach. In section 3, we describe the submitted runs. We present the obtained results in section 4.

## 2 Supervised Approach for book detection

In this section, we present our supervised approach dedicated to book titles detection and link to their unique book ID. Firstly, we define a classification process with Support Vector Machine (SVM). Secondly, we describe the implementation of the CRF used. Thirdly, we present the use of Levenshtein distance to link books to their unique book ID.

### 2.1 Retrieving posts with book titles using SVM

To preserve the precision, we decide to perform a pre-filtering through the use of a supervised classification. We choose this solution because we do not want to apply the crf outside its learning framework. We decide to use a classification technique based on SVM because SVM have better generalization capability. We define two classes: "bibliographic field" versus "no bibliographic field". We establish a manual training set extracts randomly from the threads provided for the task. The class "bibliographic field" contains 184 posts and the class "no bibliographic field" 153 posts. For the SVM implementation, we use *SVMLight*<sup>3</sup> [4].

Regarding the settings, we made a list of the most characteristic words of our classes, we use as attributes. Figure 1 shows an example of this list.

0.01674	still
0.01337	cat
0.01307	by
0.01171	series
0.01039	an

**Fig. 1.** Example of the most characteristic words of our classes

The first column designates the score of "*Recursive Feature Elimination*" (RFE) and the second column refers to word. This list is obtained by the algorithm *InfoGainAttribute* (IGA) which reduces a bias of multi-valued attributes. After several tests, we decided to use 1 as a minimum occurrence frequency of terms combined with a list from which we have removed the words with score

<sup>3</sup> <http://svmlight.joachims.org/>

RFE equal 0. For each sub-category, we conduct 10-fold cross-validations to assess how the results generalize to a set of data.

## 2.2 Authors and book titles detection based on CRF

As part of our work, we have chosen to use an approach based on learning algorithms, more particularly on CRF. We establish a training set extracts randomly from the threads provide for the task. We manually annotated 133 posts in which we marked both book titles and author names. In total, we annotated 264 book titles and 203 author names. For constructing our CRF, we use several features presented in tables 1 and 2. For the CRF implementation, we use the tool *Wapiti*<sup>4</sup>.

Main characteristics exploited in the literature for the automatic annotation of references are based on a number of observations such as lexical or morphological characteristics, both on the fields and the words contained in the fields. We also studied the characteristics used in detecting named entities. Drawing a parallel between the task of named entities detection and the analysis of bibliographic references, we are able to extract more useful information in the characterization fields and words contained in the fields. As part of our work we decided to use a typology of features inspired by the literature.

- **Contextual features:** Once the input sequence string is tokenized, each separated token is basically treated as feature. Thank to the capacity of CRFs to encode any related information about the current observation (token), we also added several features using the other tokens around the current one. Three preceding and three following tokens have been taken as additional features. Table 1 describes the contextual features.

Feature category	Description
Raw input token	Tokenized word itself in the input string and the lowercased word
Preceding or following tokens	Three preceding and three following tokens of current token
N-gram	Attachment of preceding or following N-gram tokens
Prefix/suffix in character level	8 different prefix/suffix as in [3]

**Table 1.** Description of contextual features

- **Local features:** they are divided into four categories: morphological, local, lexical and syntactic characteristics. The morphological features that were selected to characterize the shape of the tokens. The locational features have been selected to define the position of the fields in a sequence. The lexical features have been selected to use lists of predefined words but also linguistic category of words. And lastly, the punctuation features. Table 2 describes in contextual features.

<sup>4</sup> <https://wapiti.limsi.fr/>

Morphological features		
Feature category	Feature name	Description
Number	ALLNUMBERS	All characters are numbers
	NUMBERS	One or more characters are numbers
	DASH	One or more dashes are included in numbers
Capitalization	ALLCAPS	All characters are capital letters
	FIRSTCAP	First character is capital letter
	ALLSAML	All characters are lower cased
	NONIMPCAP	Capital letters are mixed
Regular form	INITIAL	Initialized expression
	WEBLINK	Regular expression for web pages
Emphasis	ITALIC	Italic characters
Stem	-	Transformation in their radical or root
Lemma	-	Canonical form of current token form
Locational features		
Location	BIBL_START	Position is in the first one-third of reference
	BIBL_IN	Position is between the one-third and two-third
	BIBL_END	Position is between the two-third and the end
Lexical features		
Lexicon	POSSEditor	Possible for the abbreviation of editor
	POSSPAGE	Possible for the abbreviation of page
	POSSMONTH	Possible for month
	POSSBIBLSCOP	Possible for abbreviation of bibliographic extension
	POSSROLE	Possible for abbreviation of roles of entities
External list	SURNAMELIST	Found in an external surname list
	FORENAMELIST	Found in an external forename list
	PLACELIST	Found in an external place list
	JOURNALLIST	Found in an external journal list
POS Simple	Set tags	Harmonized Part of speech
POS Detail	Set tags	Detailed Part of speech
Punctuation features		
Punctuation	COMMA	Punctuation type.
	POINT	
	LINK	
	PUNC	
	LEADINGQUOTES	

ENDINGQUOTES  
 PAIREDBRACES

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Table 2: Description of local features

From these characteristics we construct vectors for each word. Following the classification, we get a list of posts containing book titles potentially. Then, our CRF allows us to annotate the area referring to book titles or author names.

### 2.3 Mapping to book Ids

Once book titles or author names detection carried out, we use the Levenshtein distance for link books to their unique book ID. Just for recall, Levenshtein distance is a string metric for measuring the difference between two sequences. Informally, the Levenshtein distance between two words is the minimum number of single-character edits required to change one word into the other. As part of our work, we use two variations of the Levenshtein distance: either the length of the shortest alignment between the sequences is taken as factor, or the length of the longer one.

For each book title found, we split it and strip each word. Then, we compare each book title with the whole of book titles extracts from the collection. For each book title, we obtained a list of the books sorted by normalized Levenshtein distance, so that the results of several distance measures can be meaningfully compared. Figure 2 presents the best three results obtained for the book entitled "The Old Man".

```
Book Name: The Old Man
Results: (' The plain old man', 0.75) (' The happy old man', 0.75) (' The Old Man', 1.0)
```

**Fig. 2.** Example of output for the book "The Old Man"

For each book title, we keep the best result which is close to 1. Then, we retrieve the unique ID of the most probable best book. If an author name is located at a maximum distance of four words, we aggregate it. Figure 3 shows a query which contains both book title and author name. Then, figure presents the result obtained for the input "Timothy Findley The Last of the Crazy People".

## 3 Runs

We submitted 5 runs for the linking task of Mining track. For each run, we use only the data set which contains book IDs, basic title and author metadata per book. Once the classification process and the annotation process done, we link books at the post level by their unique LibraryThing work ID. Concerning

```

<message>
<date>Dec 8, 2010, 11:44am </date>
<note>I'm currently reading <book>The Town That Forgot How to Breathe</book>
by <author>Kenneth J. Harvey</author>. The back cover describes it as a gothic
thriller and it's set in Newfoundland. So far, about 150 pages into it,
it's been building an increasingly creepy atmosphere.</note>
<postid>7</postid>

<threadid>103956</threadid>

<username>TheTwoDs</username>
</message>

```

**Fig. 3.** Example of post with book title and author name

```

Author + Book : Timothy Findley The Last of the Crazy People
Result ( ' The Last of the Crazy People ', 0.9)

```

**Fig. 4.** Result obtained for the input "Timothy Findley The Last of the Crazy People"

a book which occurs multiple times in the same post, we keep only the first occurrence. Figure 5 shows an example of the second post of the thread 16512. For each post, we have the content of the post, the name of the user, the thread id as well as the date and time.

```

<message>
<note>I am a school librarian and these are loved by boys this age..... <book>Time
Warp trio</book> by <author>Scieszka - 3</author> boys go back in time and have
all sorts of adventures <book>Boxcar Children</book> by Warner are great
mysteries <book>Geronimmo Stilton</book> by Stilton are more action mysteries
told by a mouse <book>Hank the Cowdog</book> by Ericson funny adventures
Good Luck! </note>
<postid>2</postid>

<username>KC9333</username>

<threadid>16512</threadid>

<date>Jul 18, 2007, 10:01pm </date>
</message>

```

**Fig. 5.** Example of post for the thread 16512

Figure 6 shows the result obtained for this post. The first column corresponds to the thread id. The second column defines the post id. The third column returns the unique LibraryThing work ID (what is shown in brackets is not present in the final version of the results file).

Let's now explain the different runs:

- **B:**

After the classification process and the annotation process, we retrieve each book title and we compare it with the whole of the titles presents within the

16512	2	94411	(The Time Warp Trio)
16512	2	9397335	(The Boxcar Children)
16512	2	7487288	(Geronimo Stilton Adventurer's Boxed Set)
16512	2	67423	(Hank the Cowdog)

**Fig. 6.** Example of results for the second post of the thread 16512

data set. This comparison is carried out by the Levenshtein distance set to the length of the shortest alignment between the sequences taken as factor.

- **B\_V2:**

After the classification process and the annotation process, we retrieve each book title and we compare it with the whole of the titles presents within the data set. This comparison is carried out by the Levenshtein distance set to the length of the longer alignment between the sequences taken as factor.

- **BU:**

For this run, we add a new feature to the CRF. This feature is to detail the punctuation marks. Once the classification process and the annotation process are done, we retrieve each book title and we compare it with the whole of the titles presents within the data set. This comparison is carried out by the Levenshtein distance set to the length of the shortest alignment between the sequences taken as factor.

- **BA\_V1**

After the classification process and the annotation process, we retrieve each book title. If an author name is located at a maximum distance of four words, we aggregate it. Then, we compare the book title and the author name, if it is present, with the information present within the data set. This comparison is carried out by the Levenshtein distance set to the length of the shortest alignment between the sequences taken as factor.

- **BA\_V2:**

After the classification process and the annotation process, we retrieve each book title. If an author name is located at a maximum distance of four words, we aggregate it. Then, we compare the book title and the author name, if it is present, with the information presents within the data set. This comparison is carried out by the Levenshtein distance set to the length of the longer alignment between the sequences taken as factor.

## 4 Results

For evaluation, 217 threads in the test set were used, with 5097 book titles identified in 2117 posts. Table 3 shows 2016 official results for our 5 runs. Our best run is BA\_V2, it has classified the second w.r.t the measure Fscore and the first w.r.t the measure precision the official evaluation measure for the workshop. The others runs have substantially similar results. However, we can see that the aggregation of author names increases performance. Compared to the best run 2016, the whole of our runs get a better precision. Several hypotheses may explain the lack of recall. Firstly, the classification process can occult posts containing



references. Secondly, the amount of training data may not be enough to be representative of every possible case.

Run	Accuracy	Recall	Precision	Fscore
Best_run_2016	41.14	41.14	28.26	33.50
<b>BA_V2</b>	<b>26.99</b>	<b>26.99</b>	<b>38.23</b>	<b>31.64</b>
BA_V1	26.54	26.54	37.58	31.11
B_V2	26.01	26.01	35.39	29.98
BU	26.34	26.34	34.50	29.87
B	25.54	25.54	34.80	29.46

**Table 3.** Official result at INEX 2016. The runs are ranked according to Fscore

## 5 Conclusion

In this paper we presented our contribution for the INEX 2016 Social Book Search Track. In the 5 submitted runs, we tested several supervised approaches dedicated to book detection. Our results present better performance with the aggregation of author names. Moreover, the Levenshtein distance set to the length of the longer alignment between the sequences taken as factor give better results than the shortest alignment.

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