Czech Text Document Corpus v 2.0

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Abstract
This paper introduces “Czech Text Document Corpus v 2.0”, a collection of text documents for automatic document classification in Czech language. It is composed of 11,955 text documents provided by the Czech News Agency and is freely available for research purposes at [http://home.zcu.cz/~pkral/sw/](http://home.zcu.cz/~pkral/sw/). This corpus was created in order to facilitate a straightforward comparison of the document classification approaches on Czech data. It is particularly dedicated for evaluation of multi-label document classification approaches, because one document is usually labelled with more than one label. Besides the information about the document classes, the corpus is annotated at morphological layer. This paper further shows the results of selected state-of-the-art methods on this corpus to offer the possibility of an easy comparison with these approaches.

Keywords: corpus, Czech, document classification, multi-label, text

1. Introduction

Automatic classification (or categorization) of text documents is very important for information organization and storage because of the significant increase of the amount of electronic documents and the rapid growth of the Internet. Many efficient approaches have been proposed. They are usually based on supervised machine learning. The documents are projected into the so-called vector space model, basically using the words as features for various classification algorithms. The approaches differ in the used methods, however the common point is that all of them need an annotated document corpus to train the parameters.

A sufficient number of the corpora in several languages, particularly in English, is freely available. However, to the best of our knowledge, there is no a Czech one.

The main goal of this paper consists in presenting a corpus of the Czech text documents. It is composed of real newspaper articles provided by the Czech News Agency (ČTK) and is available for research purposes for free. It is created for a straightforward comparison of the document classification approaches in Czech. One document is usually labelled with more than one label, therefore this corpus is usually used for evaluation of multi-label document classification. Besides the information about the document classes, the corpus is also morphologically annotated.

Another research contribution of this paper are the reported results of selected state-of-the-art methods on this corpus to offer the possibility of an easy comparison with these approaches.

The paper structure is as follows. The following section presents other text corpora for document classification freely available for research purposes. Section 3 details our corpus. Section 4 presents the results of the selected state-of-the-art methods on this dataset. The last section concludes the paper.

2. Other Text Corpora

Some important existing text classification corpora in several languages are described below.

2.1. Reuters-21578

Reuter-21578[1] corpus is a collection of 21,578 documents. The training part is composed of 7769 documents, while 3019 documents are reserved for testing. The number of possible categories is 90 and the average label/document number is 1.23. This dataset is the most frequently used benchmark for English.

2.2. RCV1-V2

RCV1-V2[2] (Lewis et al., 2004) is another text classification test collection which is freely available for research purposes. It contains about 800,000 manually categorized newswire English stories from Reuters, Ltd. RCV1 contains English documents, while RCV2 is composed of the text documents in French, German, Italian and Spanish. This dataset is also widely used as a benchmarking corpus for English and the languages mentioned above.

2.3. Other Corpora

For other corpora dedicated for text categorization, you can visit for instance [http://mulan.sourceforge.net/datasets-mlc.html](http://mulan.sourceforge.net/datasets-mlc.html).

3. Corpus Description

3.1. General Information

Czech Text Document Corpus v 2.0 is composed of 11,955 real newspaper articles provided by the Czech News Agency. The documents belong to different categories (classes) such as weather, politics, sport, culture, etc.

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¹http://www.daviddiweiss.com/resources/testcollections/reuters21578/
²https://archive.ics.uci.edu/ml/datasets/Reuters+RCV1+RCV2+Multilingual,
Each document is associated with one or more categories. It is thus beneficial to use it for multi-label document classification scenarios. The multi-label classification task is considerably more important than the single-label classification because it usually corresponds better to the needs of the current applications. The total category number is 60 out of which it is used for classification 37 most frequent ones. The reason of this reduction is to keep only classes with sufficient number of occurrences to train the models. The corpus was annotated by professional journalists from the Czech News Agency.

Table 1 shows the statistical information about the corpus. It shows for instance that lemmatization decreases the vocabulary size from 193,399 to 152,462 which represents the reduction by 21%. Another interesting observation is the distribution of the POS-tags in this corpus.

Figure 1 illustrates the distribution of the documents depending on the number of labels. It shows that the maximal number of categories associated with one document is eight, the majority of documents has two categories and the average label number is 2.55.

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All documents are automatically lemmatized and annotated with POS-tags using mate-tools.

This corpus is freely available for research purposes at [http://home.zcu.cz/~pkral/sw/](http://home.zcu.cz/~pkral/sw/).

### 3.2. Morphological Annotation

According to the definition from the Prague Dependency Treebank (PDT 2.0) project, we use only the first part of the lemma, which is a unique identifier of the lexical item (e.g. infinitive for a verb), possibly followed by a digit to disambiguate different lemmas with the same base forms.

For instance, the Czech word “třeba”, having the identical lemma, can stand for necessary or for example depending on the context. This is in the PDT notation differentiated by two lemmas: “třeba-1” and “třeba-2”. The second part containing additional information about the lemma, such as semantic or derivational information, is not taken into account in this work.

The corpus is annotated with ten POS categories defined in the PDT 2.0 for the Czech language: nouns, adjectives, pronouns, numerals, verbs, adverbs, prepositions, conjunctions, particles and interjections.

The lemmatizer and POS tagger are trained on 5853 sentences (94,141 words) randomly taken from the PDT 2.0 corpus. The performance of the lemmatizer and POS tagger are evaluated on a different set of 5181 sentences (94,845 words) extracted from the same corpus. The accuracy of the lemmatizer is 81.09%, while the accuracy of our POS tagger is 99.99%.

### 3.3. Technical Details

The text documents are stored in the individual text files using UTF-8 encoding. Each filename is composed of the serial number and the list of the categories abbreviations separated by the underscore symbol and the .txt suffix. Serial numbers are composed of five digits and the numerical series starts from the value one. For instance the file 00046_kul_nab_mag.txt represents the document file number 46 annotated by the categories kul (culture), nab (religion) and mag (magazine selection). The content of the document, i.e. the word tokens, are stored in one line separated by the space symbols.

Every text document has its lemmatized form, file with suffix .lemma, and is further associated with its POS-tags, see .pos files.

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<sup>3</sup> [http://code.google.com/p/mate-tools/](http://code.google.com/p/mate-tools/)

<sup>4</sup> [http://ufal.mff.cuni.cz/pdt2.0/](http://ufal.mff.cuni.cz/pdt2.0/)
3.4. Evaluation Protocol

All following experiments use the five-folds cross validation procedure, where 20% of the corpus is reserved for testing and the remaining part for training of the models. This corpus also contains a small development part which is composed of 500 other documents. It should be used for example to tune the hyper-parameters of the models. Note, that this subset is not taken into account in our statistical information about the corpus.

For evaluation of the multi-label document classification, it is used the standard Precision (P), Recall (R) and F-measure (Fm) metrics (Powers, 2011). For evaluation of the single-label classification, the authors use the accuracy metric.

The confidence interval of the experimental results is 0.6% at a confidence level of 0.95 (Press et al., 1996).

4. Experiments

The two following sections present the results of the selected classification algorithms on this dataset. The first section deals with multi-label document classification while the second one describes the classification score of single-label classification task.

4.1. Multi-label Document Classification

The first reported approach (Hrala and Král, 2013a) uses Bag of Words (BoW) to create the features. Non-significant words are removed using Part of speech (POS) filtering and for feature selection, the mutual information method is used. The authors show the results of three classifiers, namely Naive Bayes, Maximum entropy (ME) and Support vector machine with three traditional multi-label classification approaches. The best classification accuracy was obtained by ME classifier.

The second method (Brychcín and Král, 2014) proposes novel unsupervised features using an unsupervised stemmer, latent Dirichlet allocation and semantic spaces (HAL and COALS). These features are integrated with word features to improve classification results. Multi-label classification scenario is realized using a set of binary classifiers. Maximum entropy model is used for classification.

Neural networks are very popular in natural language processing field today and they outperform many state-of-the-art approaches with only very simple preprocessing. The following approach (Lenc and Král, 2017) uses two different feed-forward neural networks, namely multi-layer perceptron (MLP) and convolutional neural networks (CNN) to achieve new state-of-the-art results on this corpus. The authors use thresholding to realize multi-label document classification task.

The results of the above described approaches are illustrated in Table 2.

| Method                        | P   | R   | Fm  |
|-------------------------------|-----|-----|-----|
| ME (Hrala and Král, 2013a)    | -   | -   | 76.8|
| words+ME (Brychcín and Král, 2014) | 88.1| 72.7| 79.7|
| unsup+ME                      | 89.0| 75.6| 81.7|
| (Brychcín and Král, 2014)     | -   | -   | -   |
| MLP (Lenc and Král, 2017)     | 83.7| 83.6| 83.9|
| CNN (Lenc and Král, 2017)     | 86.4| 82.8| 84.7|

Table 2: Multi-label document classification results of the different approaches

work, only the first document class was considered for classification and the authors consider it as the main document category. The best classification accuracy was obtained by SVM classifier and is 91.2%.

5. Conclusions

This paper introduced a novel collection of Czech text documents. This corpus is composed of real newspaper articles provided by the Czech News Agency and is available for research purposes for free. It was created to facilitate a straightforward comparison of the document classification approaches in Czech language.

This corpus is particularly intended to evaluate multi-label document classification approaches, because one document is usually associated with more than one label. Besides the information about the document classes, the corpus is annotated at morphological layer. This paper further show the results of the selected state-of-the-art algorithms on this corpus to offer the possibility of a straightforward comparison with the future research.

We plan to submit this corpus to be a part of the Language Research Infrastructure of LINDAT/CLARIN project.

6. Acknowledgements

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