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LITL at SMM4H: an old-school feature-based classifier for identifying adverse effects in Tweets

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Abstract

This paper describes our participation to the SMM4H shared task 2. We designed a linear classifier that estimates whether a tweet mentions an adverse effect associated to a medication. Our system addresses English and French, and is based on a number of ad-hoc word lists and features. These cues were mostly obtained through an extensive corpus analysis of the provided training data. Different weighting schemes were tested (manually tuned or based on a logistic regression), the best one achieving a F1 score of 0.31 for English and 0.15 for French.

1 Overview

This article describes the participation of the students of the *LITL* master and their teachers to the Social Media Mining for Health (SMM4H) shared task 2 (Klein et al., 2020). *LITL* (stands for *Linguistique, Informatique, Technologies du Langage*, i.e. Linguistics, IT, Language technologies) is a master’s program at the University of Toulouse, France that is mainly aimed at linguistics and humanities students.

The shared task is a binary classification of Twitter messages in different languages, indicating whether the message contains a mention of medication adverse effects. Participation to this task was part of the first year students’ curriculum. At this stage, their computer skills were still limited to corpus processing and simple programs, so it was decided that the system’s architecture would be a traditional linear classifier based on ad-hoc features. This approach was also deemed justified given the heavily biased distribution of data (known to be an issue for most machine learning techniques). However, the students were encouraged to apply and hone their corpus linguistics skills, and to perform some feature engineering. The approach was the following:

1. Observe the training data with corpus analysis tools, in order to identify the main characteristics of the target (i.e. tweets evoking an adverse effect);
2. Build word lists and design simple features for each of these characteristics;
3. Design a program that computes the features’ values on the target data and implements a simple weight-based linear classifier;
4. Tune the weights in order to maximize the classifier’s performance on the validation data.

Due to the necessity to actually observe and understand the training data only the French and English sets were considered, as none of the students was proficient in Russian.

2 Technical details

For observation and actual processing in both languages the tweets were preprocessed as follows:

- retweet marks (`rt @X`) were removed;
- user names (`@XXX`) were replaced with a generic and POS-wide unambiguous proper name (*Sacha*);
- URLs and email addresses were replaced with generic placeholders (`<URL/>` and `<email/>`);
- non-standard spelling was normalised (e.g. removal of exceeding repeated letters *baaad* → *bad*);
- POS tagging and lemmatizing were performed, using the Talismane toolkit for both target languages (Urieli, 2013).

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Fifteen word lists were compiled for each language, each one targeting a specific aspect of the tweets content. Those word lists contain keywords extracted from the target tweets and non target tweets using the TXM corpus analysis tool (Heiden et al., 2010). The lists were extended with existing lexical resources such as sentiment lexicons (e.g. the SocialSent lexicon (Abdaoui et al., 2017) and the FEEL – French Expanded Emotion Lexicon (Hamilton et al., 2016)) and biomedical domain language resources (Névéal et al., 2014). Table 1 gives an overview of the word lists designed and used as features for English and French Tweet classification.

Target tweet keywords (i.e. positively correlated with adverse effect)			
Word list	Example (English)	# items (English)	# items (French)
Symptoms	<i>headache, cough, addict...</i>	378	376
Causal verbs	<i>impact, stop...</i>	41	58
Sentiment (negative)	<i>dirty, resent...</i>	3647	894
Body parts	<i>chest, joint...</i>	86	84
Medication (first set)	<i>Effexor, Paxil...</i>	21	22
Increase verbs	<i>gain, raise...</i>	52	112
Decrease verbs	<i>decline, reduce...</i>	38	107
First person pronouns and determiners	<i>I, our</i>	7	12
Negation	<i>not, cannot...</i>	9	15
Emojis (negative)	☹, ☹	23	23
Non target tweet keywords (i.e. negatively correlated with adverse effect)			
Word list	Example (English)	# items (English)	# items (French)
Misc. verbs	<i>approve, study...</i>	18	8
Sentiments (positive)	<i>great, secure...</i>	2080	848
Medication (second set)	<i>Floxin, Prozac...</i>	40	9
2nd and 3rd person pronouns and determiners	<i>you, himself</i>	17	22
Emojis (positive)	☺	57	57

Table 1: Word lists designed and used as features

Each word list led to a numeric feature corresponding to the raw frequency of matching lemmas in the tweet. Two different strategies were considered for dealing with multi-word expressions. Runs 1 and 3 count all items as matches even in case they are also part of an item in another list, e.g. *skin* (body part) and *skin rash* (symptom). In contrast, run 2 only counts the longer item (e.g. *skin rash* as a symptom feature).

Three additional non-lexical features were also used: number of hash tags, number of URLs and number of Twitter user names (i.e. *Sacha*, cf. *supra*).

Each feature was assigned a weight proportional to its relative importance in the decision process. For runs 2 and 3 the weights were individually fixed based on the frequency ratios in target (vs non target) tweets in the training data, and then manually adjusted based on the scores obtained on the validation sets. The best weights were found by progressively increasing the weight of each feature independently of each other until the best F1 score is reached. For run 2, we adopted a principle of equality between features. For run 3, some features were considered as more important than others on the basis of manual observations. Run 1 used a standard logistic regression classifier trained on training data.

3 Results and discussion

Table 2 shows the results for each run and for each language on the validation and test sets. The first strategy for dealing with multi-word expressions was clearly better. Manual tuning of the feature weights (which was performed before the students were introduced to machine learning techniques) was promising on the validation set (especially regarding precision) but proved to be much less robust in the test set. Further experiments will be performed in order to assess the added value of selected word lists, compared to more straightforward and non-selective bag-of-words methods, and of course more recent NLP techniques based on word embeddings and neural classifiers.

Language	Run	Validation			Test
		R	P	F1	F1
English	1 (logistic regression, all items)	0.40	0.16	0.23	0.31
	2 (adjusted, longer items only)	0.55	0.23	0.32	0.25
	3 (adjusted, all items)	0.24	0.56	0.33	0.27
French	1 (logistic regression, all items)	1.00	0.13	0.22	0.15
	2 (adjusted, longer items only)	0.50	0.13	0.20	0.00
	3 (adjusted, all items)	0.33	0.18	0.23	0.12

Table 2: Results

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