

Analysis and Creation of Free Sentiment Analysis Programs¹

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SUMMARY

This paper analyzes free online programs for sentiment analysis which can, on the bases of their algorithm, give a positive, negative or neutral opinion of a text. At the beginning of the paper sentiment analysis programs and techniques they use such as Naive Bayes and Recurrent Neural Networks are presented. The programs are divided into two categories for analysis. The first category consists of sentiment analysis programs which analyze texts written or copied inside the user interface. The second category consists of programs for analyzing opinions posted on social networks, blogs, and other media sites. Programs from both categories were chosen for this research on the bases of positive reviews on computer science portals and their popularity on web search engines such as Google and Bing. The accuracy of the programs from the first category was checked by inserting the same sentence from movie reviews and comparing the results. Their additional options have also been analyzed. For the second category of programs, it was determined which social networks, blogs, and other social media they cover on the internet. The purpose of this analysis was to check the overall quality and options that free sentiment analysis programs provide. An example of how to create one's own custom sentiment analyzer by using the available Python code and libraries found online is also given. Two simple programs were created using Python. The first program belongs to the first category of programs for analyzing an input text. This program serves as a pilot program for Croatian which gives only the basic analysis of sentences. The

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second program collects recent tweets from Twitter containing certain words and creates a pie chart based on the analysis of the results.

Keywords: sentiment analysis, social media, text processing, program creation, algorithms

Introduction

The Internet is a free medium which enables its user to state freely whatever they want (Malović et al., 2014: 116). It is possible to get multiple opinions and reviews about anything by doing a simple Internet search. Social networks also enable the inclusion of more people in the communication channel that is always active and open. People take photos and write stories about events that are shared online by their friends and friend's friends. They become unofficial news reporters and push their opinion on certain topics and give support to certain things (Malović et al., 2014: 52). New Internet media is different from classic media such as newspapers and television because readers can communicate directly with the reporter and among themselves (Malović et al., 2014: 57). Unfortunately, there is too much content online so it is impossible to gather and analyze everything to get a general opinion or rating on something. That is why sentiment analysis tools are being developed. They automatically collect certain content online based on search criteria and on the bases of their algorithm decide if the sentiment for a text is positive, neutral or negative (Pawar et al., 2007: 26-27). Most of these programs are not accurate because they cannot deal with the use of words in different contexts or in complex sentences (e.g. *He didn't say that he didn't like the movie.*). It is hard to make a computer program which can differentiate between all grammatical forms and semantic nuances, understand sarcasm, differentiate between many meanings of words, understand idioms or deal with misspelled words. For example in the sentence *Apple is good.* the word *Apple* can mean 'fruit' or 'a famous computer company'. After analyzing other sentences in the text in which this sentence occurs, the algorithm may be able to categorize the word *Apple* as a fruit or a company. Another problem is that people usually like to mention a lot of negative features about people, places, movies, games, etc., even if they have a generally positive opinion in the end. Also, the strength of the sentiment has to be accounted for. For example, in some programs, the word *beautiful* can be rated more positive than the word *correct*. Some adjectives such as *virtual* or *physical* can be difficult for sentiment analysis because someone can prefer the virtual world to the physical one or vice versa. That is why programs have to account for adjectives in combination with other words (mostly nouns). For example, a review of the game *Deadly Premonition* by Ryan Winslett (2013) on the site *CinemaBlend* has the title stating that this game is a

wonderful mess, which can be interpreted that the reviewer thinks that the game is good despite its problem or that the game is really bad. Because of the combination of the positive word *wonderful* with the negative word *mess* the game title received different classification by two sentiment analysis programs. One program (<https://www.danielsooper.com/sentimentanalysis/default.aspx>) gave the game a completely negative sentiment of -100% and the other program (<http://sentiment.vivekn.com/>) gave the game a very positive sentiment of 94.81%. If we read the review we can see that Winslett (2013) mentions many problems connected with the game but in the end, he says that he likes it: *Seemingly poor game design that would have sent me screaming from most modern offerings only sank the hooks in deeper in the case of Deadly Premonition. I don't know why that is and, honestly, I don't want to know, either. None of that stuff matters. What matters is the fact that I love this unusual gem just the way it is, imperfect blemishes and all.* When the whole review was copied into the two programs mentioned above both programs gave a positive sentiment. However, the first program (the one that gave the negative sentiment to the review title) gave a low positive sentiment for the game of 35,4%. The other program once again gave a very positive sentiment (100%). Reviewer's rating for the game is 5/5, which means that it can be interpreted as a perfect game although Winslett (2013) mentioned many serious problems such as bad gameplay, graphics, and design. Despite that, he loved the unique bizarre charm of the game and its storyline so he gave the game a very good score. His score was more connected to his feeling than to general judgment which is impossible for the computer to figure out with an algorithm.

Methods of Sentiment Analysis

Previously used sentiment analysis programs gave different scores. The reason for this is that they use two different algorithms that use different corpora as their training data. The corpora can differ in size and use texts of different types. For example, there are corpora that only contain texts used for identifying mistakes that language learners usually make. There are also corpora containing only texts about sports, politics, technology, movies, games, art, education, etc. Larger corpora are usually much better for sentiment analysis because they have more examples of words in sentences, idioms, and collocations. Many programs usually use many different corpora so they can categorize the text better. For example, if a text has words like *play*, *ball*, and *half-time*, the program would automatically assume that this text is about sports and would mostly use sports corpus for analysis. For a more precise classification of texts sentiment analysis programs must have large corpora that cover all human activities and interests. Online corpora can be found and analyzed using the program Sketch Engine (<https://www.sketchengine.eu/>) which is free for institutional or academic use as access to Sketch Engine is paid for by the ELEXIS project

and will last until March 2022. The program can also be used for creating the users own personal corpus. It has more than 90 languages, including Croatian. Each language has one or more corpora. The user can search all corpora at once or choose a specific corpus. The program shows collocations of words so the user can see the examples of certain words being used in many different contexts. There are also other options such as generating lists and word clouds for words that are usually used with the selected word, frequency lists which take into account morphological analysis and part-of-speech tagging and word sketches which show collocations of words categorized by grammatical relations such as words that occur as an object or a subject of a selected verb, words that modify the selected word, etc. (Fig 1.). There are also options for comparing two words. So Sketch Engine offers many possibilities for working with corpora (Hanks et al., 2018).

Two of the most well-known algorithms for text analysis are Naive Bayes and Recurrent Neural Network (LSTM). Naive Bayes classifier works on the bases of Bayes theorem of probability where entities are classified according to their regular independent features (Smola and Vishwanathan, 2008: 23). For example, fruit that is red and round will be classified as an apple because apple is the most popular fruit with these features. Of course, this can be a mistake because apples can also be green and there are other red and round fruits such as cherries, peaches, and raspberries. That is why Naive Bayes algorithms can sometimes make mistakes but they can improve

Figure 1. Example of creating a word sketch in Sketch Engine for the Croatian word *proljeće* 'spring'

Slika 1. Primjer generiranja skice riječi za riječ *proljeće* u programu Sketch Engine

The screenshot shows the Sketch Engine interface for the word 'proljeće' (spring). The main window displays a list of grammatical relations (e.g., koordinacija, imenica_iza_prijedloga, koga-što, prijedlog-iza, komu-čemu, particip, u_genitivu-n, n-koga-čega, biti_kakav?, infinitiv, oba_u_genitivu, koga-čega, a-komu-čemu, a-koga-što, a-koga-čega). Below this, there are five panels showing collocations for different parts of speech:

glagol_ispred_prijedloga	prijedlog	kakav?	veznik	subjekt_od
u-s ... početkom proljeća	početkom ... početkom proljeća	goranov ... Goranovo proljeće	kada ... u proljeće kada	pokucati ...
na-s ...	tijekom ... tijekom proljeća	rani ... u rano proljeće	svi ... proljeće sve	zakucati ...
do-s ...	krajem ... krajem proljeća	arapski ...	čim ... u proljeće čim	stići ... Proljeće je stiglo
sa-s ...	tok ... tokom proljeća	novigradski ... Novigradsko proljeće	kad ... u proljeće kad	donijeti ...
Za-s ...	sredina ... sredinom proljeća	praški ... Praškog proljeća	pa ... proljeće pa	doći ... Proljeće je došlo
nakon-s ...	do ...	orahovački ... Orahovački proljeće	ili ...	početi ...
iz-s ...				dočekati ...
uz-s ...				

(Sketch Engine, 2018)

their accuracy of classification by processing more examples with a larger corpus from which they learn different keywords crucial for the analysis. The algorithms also learn which words form together different meanings in a sentence. Bayes model can also be easily implemented in many different programs or programming languages because its algorithm is available free of charge online (Bobriakov, 2017). In chapter *Creating one's own sentiment analysis program* a demonstration of how to implement this algorithm in Python for sentiment analysis of Croatian texts is given. Recurrent Neural Networks algorithm is used for analyzing a sequence of data. This algorithm is used in applications such as Apple Siri and Google Voice Search. It has an internal memory that can store previously input words that can be used for analyzing and predicting new inputs. This is why this algorithm is used for analyzing speech, text, financial reports, weather reports, audio and video files. For example, if a user gives *Big Apple* as an input the algorithm can connect the word *Big* and *Apple* both written with capital letters and guess that this is a phrase meaning New York City. This feature is absent from previous Naive Bayes algorithms. However, it is much more difficult to implement Recurrent Neural Networks algorithm in programs than Naive Bayes algorithm. Nevertheless, there are still libraries and modules online that can be used free of charge for implementation in programming languages Python and Java (Donges, 2018). There are also other algorithms for text classification, e.g. Convolutional neural network can be used for classifying sentiment inside images.

Previous Work on Croatian Sentiment Analysis

Mäntylä, Graziotin and Kuutila (2017: 2) mention that there is an increase in the number of papers on sentiment analysis. According to them, nearly 7,000 papers on this topic have been published and 99% of them have appeared after 2004 making sentiment analysis one of the fastest growing research areas. Mäntylä, Graziotin and Kuutila (2017: 2) also mention that citation counts on this topic have also increased along with the paper counts. Mäntylä, Graziotin and Kuutila (2017: 25) also mention that the top-cited paper on Google Scholar and Scopus on sentiment analysis exceeds the citation counts of any paper published in an older and larger research area of software engineering. Thus, sentiment analysis is also making an impact when measured by the number of citations. Mäntylä, Graziotin and Kuutila (2017: 25) in the conclusion of their paper mentioned that recent papers about sentiment analysis from 2014 to 2016 focus more on social media such as Twitter and Facebook. Unfortunately, sentiment analysis tools and programs mostly work only for English. Preradović and Jakopović (2016: 63-82) examined the possibility for creating sentiment analysis program using the program SentiStrength for Croatian by analyzing user comments on Croatian news portals. Preradović and Jakopović (2016: 68) analyzed user comments on media reports about organizations in the domain of passen-

ger transport – Croatia Airlines, Zagreb Electric Tram, and Croatian Railways. Based on sentiment analysis and word frequencies in user comments, Preradović and Jakopović (2016: 67) created a computer lexicon of sentiment words for the domain of transportation. Preradović and Jakopović (2016: 78-79) also identified the key challenges of sentiment analysis of Croatian, but also of other morphologically rich Slavic languages, based on the comparison, correlation analysis, and measurement of the relative error of computer sentiment analysis in relation to the human sentiment analysis. Croatian has a rather small number of language resources, it has a very complex morphology, and has specific letter signs *č*, *ć*, *š*, *ž*, and *đ*. Glavaš et al. (2012: 166) have created a sentiment lexicon CroSentiLex for Croatian which consists of 1200 lemmas with a positive and negative polarity. Merklér and Agić (2013: 115) have implemented the program Sentiscop for detecting sentiment in horoscopes on news portal websites. Agić, Ljubešić and Tadić (2010: 1164-1167) presented results of the experiment dealing with sentiment analysis of Croatian texts from the domain of finance. Agić, Ljubešić, and Tadić (2010: 1166) created a small gold-standard corpus of newspaper articles and annotated it manually for general sentiment and polarity phrases within the text. The resource has shown that general sentiment of the articles is governed by polarity phrases contained within the articles, i.e. that articles carrying a positive overall sentiment will usually contain more positive polarity phrases than the phrases with negative polarity, making it possible to calculate overall polarity of unseen articles by counting polarity phrases detected within them. Agić, Ljubešić and Tadić (2010: 1166-1167) also developed a prototype module for automatic detection and classification of polarity phrases in an unseen Croatian text from the domain of finance by using a cascade of local (regular) grammars. The module performed with high precision and satisfactory recall on unseen texts. Glavaš, Korenčić and Šnajder (2013: 19-21) proposed methods for acquiring a domain-specific opinion lexicon by using a semi-automatic method to acquire opinion clues (“good”, “bad”) and aspects (“pizza”), then aiming to pair in each sentence (“good pizza, but lasagna was terrible”) the aspects (“pizza”, “lasagne”) with the opinion clues (“good”, “terrible”) that target them (“good pizza”, “terrible lasagne”). By using extracted aspects, clues, and aspect-clue pairs the overall opinion from reviews for restaurants from Pauza.hr, the largest food ordering website in Croatia, was predicted. The dataset contains 3310 reviews, totaling about 100,000 tokens. In the experiment the model that used opinion clue features or opinionated aspect features showed better results than the basic bag-of-words model that only used (multiset) words, disregarding grammar and word order. The research confirmed that opinion clues and opinionated aspects improve the prediction of the overall opinion of the review. The method of Glavaš, Korenčić, and Šnajder (2013: 21) showed that a supervised model with linguistic features can effectively assign opinions to the individual product aspects and demonstrated that opinion clues and opinionated aspects improve prediction of overall review polarity and user-assigned opinion rating.

Free Programs for Sentiment Analysis

Lin et al. (2018: 95) have analyzed five sentiment analysis programs and tools by testing them with datasets from the software engineering domain. The results of their research indicate that sentiment analysis is not yet well developed for analyzing texts that describe technical problems because there are not many emotional words present and there is still a problem with the accuracy of determining positive or negative sentiments. However, neutral sentiments are easier to predict. Texts from social networks and reviews can therefore sometimes be easier to analyze than technical, professional or scientific texts because they are shorter and mostly use more adjectives or words with stronger positive or negative sentiments. There is still a problem with analyzing texts written in an informal style on social media which have a lot of slang words, emoticons, idioms, mems, expressions of irony, and jokes that sentiment analysis has to grasp. There are other papers that focus on using certain sentiment analysis programs as research tools but the comparison of these programs and options they offer has not as yet been in the focus of research papers. There are many online programs that can be used for sentiment analysis of English texts. Most of these programs are not free and they mostly collect data from social networks. Many programs have demo versions which can be used by filling out the forms and some programs are free for a certain time period. This paper will focus on programs that are permanently free of charge. Some of the free programs such as Google Cloud Natural Language API only require registration in order to be able to use the program. In addition to comparing free sentiment analysis programs, the process of creating such programs in Python will also be analyzed. This research of sentiment analysis was done for the project *Croatian Online Dictionary - Mrežnik* (<http://ihjj.hr/mreznik/>). The result of the *Mrežnik* project will be a free, monolingual, hypertext, searchable, online dictionary of Standard Croatian with ten thousand dictionary entries compiled during the four-year period. At the end of the project 28th February 2021, the dictionary will be available online on the domain rjecnik.hr (Hudeček and Mihaljevič, 2017: 208). The aim of the research was to check all the options that different sentiment analysis programs have in the field of text processing for possible implementation of some of the features of the online dictionary *Mrežnik* (word lists and morphological data) and application on *Mrežnik* data (marking of sentiments for certain entry or subentry words). As *Mrežnik* has many pragmatic features as well as a rich morphological base sentiment analysis could maybe be applied to it or some of its results could be useful for future sentiment analysis. There isn't as yet any advanced algorithm for sentiment analysis of Croatian. This doesn't mean modern language technology should not be studied and one day it should be available for implementation in other languages.

Methodology

The programs were selected for analysis on the bases of their positive reception on many IT sites such as *Template.NET* (<https://www.template.net/business/tools/sentiment-analysis-tool/>) and *talkwalker* (<https://www.talkwalker.com/blog/best-sentiment-analysis-tools>) and their ranking on Google searches. The programs were divided into two categories depending on their purpose. One category consisted of programs for analyzing texts written or pasted into the user interface and the other consisted of programs for analyzing the content of social media and blogs. That is why each of the categories of programs is analyzed in a different way. The aspects of analysis were decided after overviews of many programs and seeing many similarities between them and possible features they can have. To fulfill the aim of the research, i.e. checking all the options and possibilities that sentiment analysis programs have for implementation in *Mrežnik*, certain questions need to be answered for each category of programs. The questions for programs belonging to the first category are how accurate will the analysis be depending on the complexity of the sentence and which program seems to be the most developed taking into consideration the options such as displaying crucial keywords, word categorization, displaying the results through graphs and charts, and the ability to use other languages in addition to English. The questions for programs belonging to the second category are which social media they mostly cover, how do they graphically display the results of the analysis, and do they display analysis for each post separately or do they only give the overall result of analysis of all posts together. All these questions will be displayed and the answers shown in the tables below.

Programs for Analyzing Texts in the User Interface

This category consists of eight popular programs. Their features such as showing keywords that were crucial for analyzing, registration requirement, ability to use the program for different languages in addition to English, deciding on the category or topic of the text based on the words that were used, creating word clouds, creating charts and showing the user which words were categorized for the positive, negative or neutral sentiment were checked. There is also a short comparison of results of the analysis of modified sentences² from the review of the horror-comedy *Toxic Avenger: Though it is silly, sleazy, and graphically violent, The Toxic Avenger does hold a bit of warped charm and I love it.*

Table 1. Comparing programs – analyzing the sentiment of an input text
Tablica 1. Usporedba program za analizu sentimenta unesenoga teksta

Name of the program	Registration	Showing key word for analysis	Ability to use the program for different languages	Categorization of the text
Daniel Soper Sentiment Analyser	no	no	no	no
SentiStrength	no	no	yes	yes
Sentigem: Sentiment Analysis API	no	no	no	no
Text Analytics & Sentiment Analysis API	no	yes	no	no
IntentCheck	yes	no	no	no
Google Cloud Natural Language API	yes	yes	yes	yes
Sentiment Tool	no	no	no	no
Microsoft Text Analytics API	yes	yes	yes	no
	Creating word clouds	Creating charts	Showing user sentiments for each word	Sentiment for input text
Daniel Soper Sentiment Analyser	no	no	no	positive
SentiStrength	no	no	no	neutral
Sentigem: Sentiment Analysis API	no	no	no (only for sentences)	positive
Text Analytics & Sentiment Analysis API	yes	no	yes	negative
IntentCheck	no	yes	yes	neutral
Google Cloud Natural Language API	no	no	yes	positive
Sentiment Tool	no	no	no	positive
Microsoft Text Analytics API	no	no	no	negative

Results

The results of this analysis show that most programs recognize the positive sentiment for the movie. Two programs gave negative sentiments and two gave neutral sentiments. This movie has a positive review which any human can recognize when

at the end of the review the reviewer says that he loved it. However, words such as *sleazy* and *graphically violent* have a very negative context which can make analyzing the sentence difficult for certain programs. It is hard to decide which of these programs is the most accurate because that would require multiple analysis of results given for much larger texts from many different areas. The fact that half of the programs recognized the positive review from a complex sentence with many negative words shows that accuracy for sentiment analysis tools can be of use and will hopefully improve with time.

IntentCheck (<https://www.intencheck.com>) program has more options than most sentiment analysis tools. It also has a well designed modern interface. It uses colors to mark a certain sentiment of text and has options to export statistical results of analysis such as tables, keywords, and charts in a PDF format (Fig. 2). There is a grade for each sentiment in the text and a list of words that belong to a certain sentiment. The attitude rendered by certain words is also being scored as strong, weak, active, and passive. Registration is needed to use this program.

Google Cloud Natural Language (<https://cloud.google.com/natural-language/>) API can categorize certain words from the text in many different areas (person, art, company, places, etc.) and graphically show connections between the words in sentences which lead to the conclusion about the sentiment of the text. That is why this

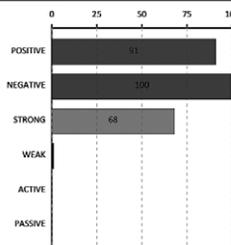
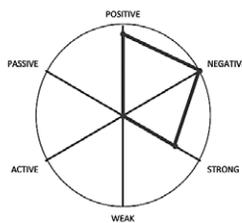
Figure 2. Results of analysis given by IntentCheck program

Slika 2. Prikaz rezultata analize dobivenih iz programa IntentCheck

RESULTS

ATTITUDE GROUP

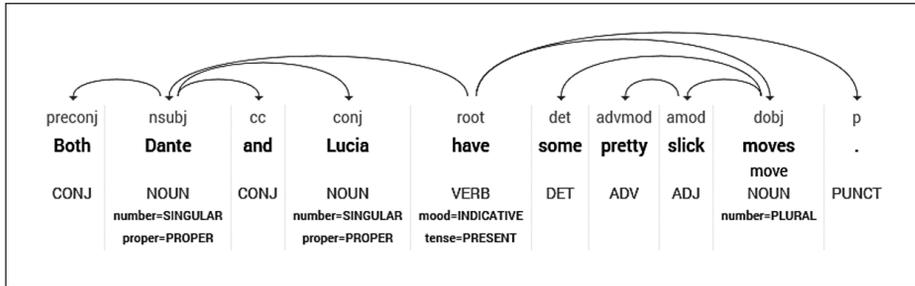
Category	Grade	Value	Words	Highlighted words
POSITIVE	HIGH	91	49	abilities, ability, able, advantage, basic, better, colorful, distinct, effective, engaging, en...
NEGATIVE	VERY HIGH	100	48	adverse, against, bad, bland, blatant, boring, challenge, charisma, close, complex, concern, cr...
STRONG	NORM	68	56	able, action, add, addition, additional, advantage, big, blatant, boss, challenge, charisma, co...
WEAK	VERY LOW	1	13	baby, bland, defensive, devoid, lack, little, need, only, piece, serve, small, unfortunate, wea...
ACTIVE	VERY LOW	0	52	action, alternate, better, boss, buy, care, challenge, collect, combat, come, control, cross, d...
PASSIVE	VERY LOW	0	39	allow, become, been, being, boring, complete, concern, cool, creature, defensive, disappointmen...



(Intentcheck.com, 2018)

Figure 3. Relations between words generated by the analysis in Google Cloud Natural Language API

Slika 3. Prikaz analize odnosa među riječima unutar programa Google Cloud Natural Language API



(Cloud Natural Language, 2018)

program has higher accuracy as compared to other sentiment analysis tools analyzed in this paper. It lacks some options in displaying results such as charts but supports some other languages (in addition to English) such as Chinese, French, German, Italian, Japanese, and Spanish. It only requires a Google account to use it. Compared to Google Cloud Natural Language Microsoft Text Analytics API (<https://azure.microsoft.com/en-us/services/cognitive-services/text-analytics/>) has many limitations such as not being able to process texts that have more than 5 000 characters. In addition to English, it can also analyze words in Spanish but not as precisely as in English. It has a very poor display of results and only shows the percentage of the overall results and types out some key phrases of the analysis. It also isn't as accurate as the two previously mentioned programs. Text Analytics & Sentiment Analysis API (<https://text2data.org/>) have an option to create simple word clouds that consist of keywords of analysis. The drawback is that this program is also very slow. Daniel Soper Sentiment Analyser (<https://www.danielsoper.com/sentimentanalysis/default.aspx>) and Sentiment Tool (<http://sentiment.vivekn.com/>) don't have any extra features in addition to simple sentiment analysis. Daniel Soper Sentiment Analyser also has a very old user interface so this program is out of date in its design and functionality. From all the programs SentiStrenght (<http://sentistrength.wlv.ac.uk/>) has the largest number of options for analyzing other languages such as Finnish, German, Dutch, Spanish, Russian, Portuguese, French, Arabic, Polish, Persian, Swedish, Greek, Welsh, Italian, and Turkish. This program can be configured for other languages and contexts by changing its input files. It was previously mentioned that Preradović and Jakopović (2016: 69) did this when they analyzed user comments on Croatian transportation sites. However, the analysis for

other languages is still not as developed as for English. There is also an option for downloading the program locally or implementing its algorithm in Python or Java, so this program is easily customizable. The program gives two scores. One for the negative sentiment and the other for the positive sentiment. It uses two scores because research in psychology has revealed that we process positive and negative sentiments at the same time.

From this category of programs the first two mentioned programs Google Cloud Natural Language API and IntentCheck seem to be the most developed. Google Cloud Natural Language API is probably more accurate and IntentCheck has better options for displaying the results of the analysis. SentiStrenght is the program that is most appropriate for analyzing texts in other languages. Other programs can also be used for analyzing texts but they do not have any outstanding or unique features. The major problem of the analyzed programs is that most sentiment analysis programs only focus on English. Some can analyze some other “big” languages, i.e. languages with a large number of speakers, such as Spanish but the accuracy of the analysis is not as high as for English.

Programs for Analyzing Sentiment on Social Media

Social networks are the main source of information on opinions and sentiments towards different topics as many people spend a considerable amount of time on social media. However, the communication on social media has many drawbacks connected with the fact that different reactions of different users can appear, and not all users respect the netiquette. So we can mostly find criticism and sometimes very rude comments (Malović et al., 2014: 131). That is why sentiment analysis on social media can show very negative results when analyzing only user comments. The ability to analyze negative sentiments automatically, especially offensive content and hate speech, if programmed correctly, can be used in the future for blocking certain user comments.

None of the programs for analyzing sentiments on social media require registration. For this analysis four programs that can collect and analyze posts from social networks, blogs, and other social media sites have been selected. These programs cover different sites and show the results of the analysis in different ways. The reason why there are fewer programs in this category than in the previous one is that there aren't many free online programs for analyzing social media. Programs that are usually categorized as sentiment analyzers like BuzzSumo don't belong to this category because they do not analyze sentiment but rather count user engagement through the number of clicks and shares. The focus of this analysis was on which social media and other news sites were covered and how the results of sentiment analysis

were displayed. For example, some programs can only show the overall sentiment for all collected posts and some show sentiment for each post separately. Some programs show results using charts, tables, timelines, word clouds or even geographic maps which mark the locations of users having a certain sentiment.

Table 2. An overview of social media and news sites that programs for sentiment analysis take into account

Tablica 2. Pregled društvenih mreža i drugih obavještajnih stranica koje programi za analizu sentimenta pokrivaju

Name of the program	Face-book	Twitter	Insta-gram	Reddit	blogs and microblogs	other sites
Social Mention	no	yes	no	yes	yes	Photobucket site for images and videos
Social Searcher	yes	yes	yes	yes	yes	other social networks like YouTube, Flickr, Thumblr, Wikipedia and some commercial sites such as Apple and CNET
Tweet Sentiment Visualization App	no	yes	no	no	no	no
Keyhole	no (only the paid version)	yes	yes	no	yes	YouTube and some other social sites

Results

All of these programs cover Twitter. Sentiment analysis is mostly developed for Twitter because most of the posts are publicly available and easily searchable, which means that it is easy to collect and analyze a huge amount of posts from certain users or tweets that have certain words as hashtags #. The main reason for focusing on the Twitter profile data is that it is possible to get quantitative information from this platform because Twitter contains authenticated accounts of politicians, which is not the case with Facebook, Instagram, and some other sites (Hasan et al., 2018:2). Twitter has also become a primary source of certain news as politicians, and celebrities use it for their announcements (Malović et al., 2014: 248). However, most sentiment analysis tools also cover Instagram and Facebook. Both of these sites have hashtagging options which help in finding posts on certain topics from different

Table 3. Comparing options of programs for sentiment analysis on social media and other news sites

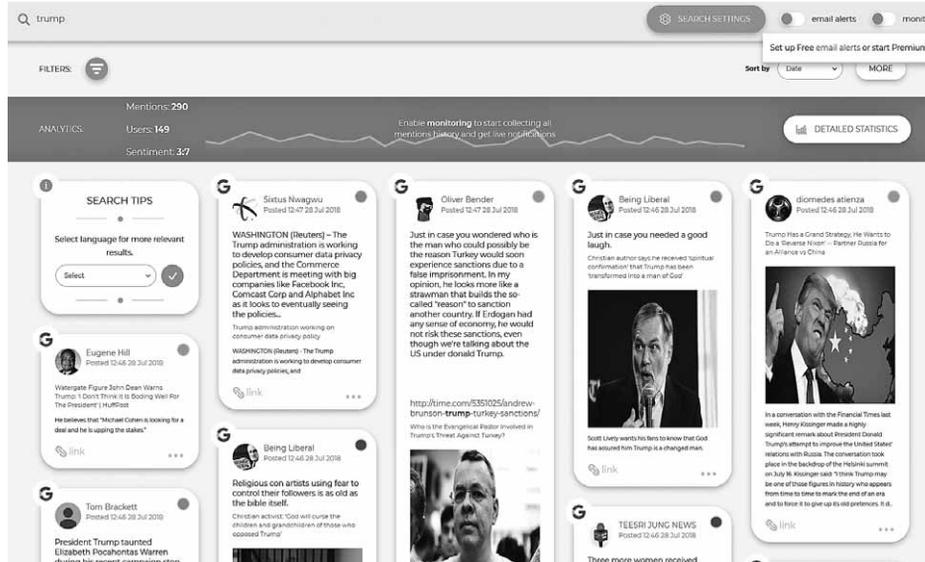
Tablica 3. Usporedba mogućnosti program za analizu sentimenta na društvenim mrežama te drugim obavještajnim stranicama

Name of the program	sentiment score for every post	overall sentiment for the entity that was searched	charts	tables with keywords of analysis	word clouds	other visual displays of data
Social Mention	yes	yes	no	yes	no	no
Social Searcher	yes	yes	yes	yes	yes	timeline that shows the number of posts of recent dates
Tweet Sentiment Visualization App	yes	yes	yes	yes	yes	placing sentiments in certain topics, creating heatmaps and timelines, showing the country where most sentiments come from on the map
Keyhole	no	yes	yes (however they are blurry for the free version of the program)	no	yes	showing the popularity of the searched entity on the world map and listing most influential and recent users that posted about searched topic on Twitter

users. It is also interesting that Reddit is covered as well since it functions more like a forum. Most of these programs also cover sentiments of user comments on videos on YouTube and images on Flickr.

All programs except Keyhole (<https://keyhole.co/>) give sentiments for each post separately. Social Searcher (<https://www.social-searcher.com/>) is the program that covers most social media sites and has many statistical and graphical options for presenting the results (Fig. 4). Therefore it seems to be the most complete program from the list.

Figure 4. Results of the search displayed in the Social Searcher program
 Slika 4. Prikaz rezultata pretraživanja u programu Social Searcher



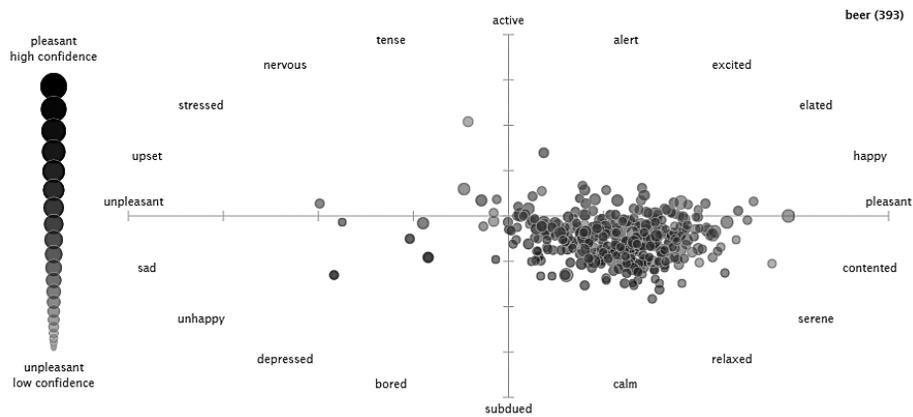
(Social Searcher, 2018)

Tweet Sentiment Visualization App (https://www.csc2.ncsu.edu/faculty/healey/tweet_viz/tweet_app/) only concentrates on Twitter. It has a detailed statistical view of data with timelines, heatmaps, tag clouds, affinity graphs, and a geographical map of tweets. This program is, therefore, the best option for analyzing tweets. Sentiments are also shown in graphs that have a specter of many different emotions (Fig. 5).

Social mention (<http://socialmention.com/>) has only a very basic display of results without using any distinct features. It gives tables for sentiment results, keywords, top users and top hashtags. All the results from tables can be downloaded in a .CSV format which can be opened and edited in Excel for further research or creation of custom charts. The last program from the table Keyhole provides detail graphical analysis but it has sentiment charts that become blurry unless the user registers and some options require payment. Although it takes a lot of time to collect posts the advantage is that this program shows which devices the users usually use for posting like iPhones, Android devices, and desktop or laptop computers.

Figure 5. Tweet Sentiment Visualization App puts tweets in many different specters of emotions

Slika 5. *Tweet Sentiment Visualization App* svrstava tweetove u različite spektre emocija



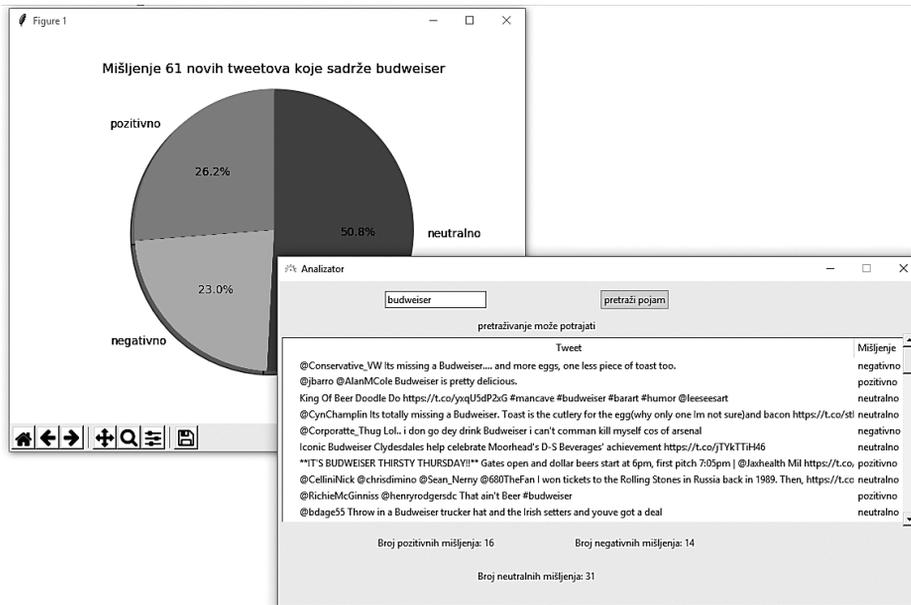
(Tweet Sentiment Visualization App, 2018)

Creating one's own sentiment analysis program

In addition to available free online programs, there are a lot of available algorithms that can be easily implemented in different programming languages. In this example, the process of creating one of the sentiment analysis tools will be shown. It will be created using the programming language Python that is usually used at schools for teaching programming (Brođanac et al., 2013: 10). The advantage of Python as compared to other programming languages such as C# or Java is that it has a much simpler syntax so it is not difficult to learn and it is well designed for text processing. Before writing a code for the program, one needs to have one's own corpus of words that is used as training data for the program. Some algorithms even insist on having keywords that are important for recognizing the sentiment of a text. The first program was created for analyzing tweets by using Tweepy library for Python (<http://www.tweepy.org/>). In order to collect Twitter posts, the user must have a Twitter account to get an API key. Then the user can search for recent tweets that contain certain words. Unfortunately, sometimes there is a limitation of the number of tweets the program can gather and analyze before it crashes. It is mostly limited to only 60 tweets per search. The results of sentiment analysis are stored in an Excel file. There is also an option to automatically create charts using the *matplotlib* library (<https://matplotlib.org/>) (Fig. 6).

Figure 6. The program developed in Python which collects and analyses tweets and displays results in tables and pie chart

Slika 6. Program izrađen u Pythonu koji prikuplja i analizira tweetove te rezultate prikazuje u tablici i grafikonu



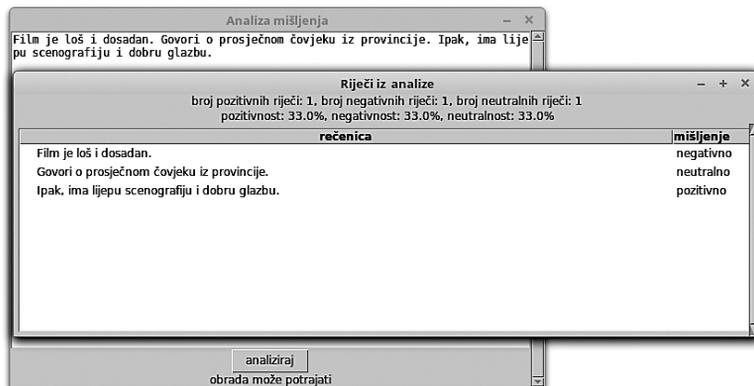
(screen captured from personal computer, 2019)

The second program was created for analyzing input texts in Croatian by using Naive Bayes algorithm within the TextBlob library (<https://textblob.readthedocs.io/en/dev/>). In this program, the users can modify the results of analysis by adding their own positive, negative, and neutral words or sentences in .txt files. The program gives a table stating which sentences in the text are classified as positive, negative or neutral. It also shows the overall sentiment score by counting the number of sentences classified into each category (Fig. 7).

The program sometimes isn't very accurate because it has a problem with recognizing derivatives and morphological forms which should be listed separately in .txt files. Also, the accuracy of the analysis depends on the number of Croatian words and sentences inserted and classified in .txt files. The accuracy of the program increases if it contains more examples of positive, negative, and neutral words and sentences. If the program doesn't have any of the input words or sentences, it will classify the text as having the sentiment that has the most examples. This can sometimes be a problem if the user has too many examples for one sentiment compared

Figure 7. The program developed in Python which gives sentiment for every sentence in the text. The results of the analysis are displayed in the table.

Slika 7. Program izrađen u Pythonu koji daje sentiment za svaku rečenicu u hrvatskome tekstu. Rezultati analize za svaku rečenicu prikazani su u tablici.



(screen captured from personal computer, 2018)

to the other two sentiments. In that case, the program mostly classifies everything with that sentiment. Positive and negative words were taken from the word list of the *Croatian Web Dictionary - Mrežnik* (in this demo version only the module for foreigners) and annotated manually. This is a small training corpus for sentiment analysis used for the purpose of testing sentiment analyzers. It will hopefully expand in the future and consequently improve the accuracy of the analysis. Positive and negative words on the list are mostly adjectives and neutral words are mostly nouns. However, certain nouns that create positive feelings such as food, holidays and family members were classified as positive and nouns that usually create negative feelings such as death, kill, and murder as negative. These two programs can be downloaded with their resources from the GitHub website which allows its creators to publish their work with all resources online free of charge (https://github.com/borna12/Tweeter_analizator, https://github.com/borna12/analiza_misljenja). The programs were compiled from .py file to the .exe file for Windows operating system. There is also a simple user interface created in the Python Tkinter module so that the user doesn't have to run command lines. While these programs are not professional like those used in sentiment analysis and can hardly be called finished because of their primitive options and the fact that the program occasionally crashes while collecting and processing data, they demonstrate that one person with some coding knowledge can create his own custom program for sentiment analysis. This means that technology used for sentiment analysis is becoming more accessible and robust.

Although no one has as yet created a complete sentiment analyzer that could be used for Croatian texts, with available algorithms and programs and Croatian corpora that can be searched by using Sketch Engine at least the future looks bright.

Conclusion

Posts on social media undoubtedly have become an important segment of modern society because the Internet users spread the news and their opinions faster than by the media that were used before. They also allow interactivity with the audience and give options to the readers to express their opinion. Because of a large number of posts on social networks, there is a need to collect them automatically and analyze them using available computer technology. This is why this paper analyzed many different free sentiment analysis programs for the purpose of seeing their possibilities and options. Programs for analyzing written texts online have mostly had rich options for displaying results of analysis through tables or lists that contain keywords of analysis, many different charts, etc. However, most of the programs only work for English and are still not accurate enough to replace human interpretation. Social network sentiment online analyzers are used more because they can gather and analyze massive data faster but they have the same problem with accuracy when analyzing posts that are generally short and use idioms, sarcasm, and slang. Accuracy can be questionable and they only work for English. However, they have many automatic options for displaying analysis results using modern graphical trends. The major problem is that there is not enough support for other languages and sentiment analysis for social media mostly covers popular sites such as Twitter, Facebook, and other websites in the USA. This is also a problem with many sentiment analysis libraries as they are designed for English. It is impossible to get an overall sentiment for a topic without taking into account other sites and blogs from many countries, which are sometimes written in different languages, especially when one analyzes e.g. the topic of war because if one analyzes only sites in English only one side of the story is visible. There are also a lot of algorithms and resources available for creating the user's own sentiment analysis programs so there is a lot of potential for developing sentiment analysis for other languages. Moreover, algorithms for detecting sentiments will become more accurate.

NOTES

- ¹ This paper is written within the research project *Croatian Web Dictionary – Mrežnik*. (IP-2016-06-2141), financed by the Croatian Science Foundation.
- ² The sentence was modified from the review on TV Guide. Accessed at: 10. 10. 2018. : <https://www.tvguide.com/movies/the-toxic-avenger/review/121084/>

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Analiza i izrada besplatnih programa za analizu sentimenta

Josip Mihaljević

SAŽETAK

U radu se analiziraju besplatni računalni programi za analizu sentimenta (mišljenja, osjećaja, stava) koji mogu izraziti pozitivan, neutralan ili negativan stav o sadržaju teksta na temelju određenih kriterija unutar algoritma. Na početku rada objašnjava se što su programi za analizu sentimenta, kojim se tehnikama koriste te se iscrpno objašnjavaju dosadašnja istraživanja. Analiziraju se dvije skupine besplatnih mrežnih programa. Jedna skupina programa služi za analizu sadržaja napisanoga ili kopiranoga teksta, a druga za analizu sentimenta objava na društvenim mrežama, blogovima ili kojemu drugom obavještajnom tipu mrežnih stranica. Programi iz obje skupine odabrani su na temelju recenzija s informatičkih portala te popularnosti na mrežnim tražilicama poput Googlea i Binga. Za prvu skupinu programa analizirane su tehnike koje se koriste za analizu teksta, dodatne mogućnosti koje se mogu koristiti tijekom analize teksta te se pokazuje koju procjenu sentimenta programi daju za odabrani dio teksta iz recenzije i koliko ga precizno analiziraju. Za drugu skupinu programa analizira se koje društvene mreže, blogove te ostale tipove obavještajnih stranica obuhvaćaju te na koji način prikazuju rezultate obrađene analizom. Iz analize obje skupine programa dolazi se do zaključka o mogućnostima njihova korištenja te kvaliteti usluga. Također se prikazuje kako se može izraditi vlastiti program za analizu sentimenta s pomoću mrežno dostupnih kodova i dodataka za programski jezik Python. Na temelju tih dostupnih resursa napravljena su dva program od kojih prvi služi kao demo inačica za hrvatski jezik te daje informacije o stavu vezanom za upisani tekst, a drugi program dohvaća posljednje tweetove koji sadržavaju određenu riječ te izrađuje grafikon koji prikazuje stavove u tweetovima koji sadržavaju tu riječ.

Ključne riječi: programi za analizu sentimenta, društvene mreže, analiza teksta, izrada programa, algoritmi