

A New Approach to Development of Recommendation Systems with Opinion Mining on Turkish User Reviews

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Abstract

People are starting to use Internet more often in their daily lives; they prefer to do more online shopping for their needs. However, e-commerce companies use a variety of recommendation systems to increase product sales. Current recommendation systems are often based on the user's personal information and online behavior. The most commonly used algorithm in recommendation systems is collaborative filtering. However, despite its wide range of applications, the prediction accuracy of this algorithm is not enough. It can also be questioned whether quantitative data such as product grading or purchasing history reflects users' true taste. For these reasons, Opinion mining is appeared as a new approach to the development of recommendation systems. In this article we propose a model to analyze Turkish user reviews that can be found a large amount on the internet, based on opinion mining. This model will contribute to the development of recommendation systems.

Keywords: Recommendation systems, Opinion mining, User reviews.

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Abstract

People are starting to use Internet more often in their daily lives; they prefer to do more online shopping for their needs. However, e-commerce companies use a variety of recommendation systems to increase product sales. Current recommendation systems are often based on the user's personal information and online behavior. The most commonly used algorithm in recommendation systems is collaborative filtering. However, despite its wide range of applications, the prediction accuracy of this algorithm is not enough. It can also be questioned whether quantitative data such as product grading or purchasing history reflects users' true taste. For these reasons, Opinion mining is appeared as a new approach to the development of recommendation systems. In this article we propose a model to analyze Turkish user reviews that can be found a large amount on the internet, based on opinion mining. This model will contribute to the development of recommendation systems.

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Introduction

People are starting to use Internet more often in their daily lives; they prefer to do more online shopping for their needs. However, e-commerce companies are using various recommendation systems to increase their product sales and to recommend products that users (customers) can deal with. Recommendation systems are technological tools, techniques, algorithms and software applications that provide information items estimated to be valuable in a given context in various domains (Robillard & Walker at al, 2014). They are classified as Content Based Recommender Systems, Collaborative Filtering, Context Aware Recommender Systems, Hybrid Recommender Systems (Aguilar, Valdiviezo-Daz&Riofrio, 2017).

Current recommendation systems are often based on the user's personal information and online behavior (Li, Wang&Yan, 2015). The most commonly used algorithm in recommendation systems is CF (Collaborative Filtering) (Youdong, Danial, Jaechoon&Heuiseok, 2017). A kind of similarity is calculated according to user ratings that are given to items in the Collaborative Filtering. In CF users do not give just rates to items, they write comments and give 0-1 (like - dislike) opinions to the items. However, despite CF's wide range of applications, the prediction accuracy of this algorithm is not enough. It can also be questioned whether quantitative data such as product grading or purchasing history reflects users' true taste (Youdong, Danial, Jaechoon&Heuiseok, 2017).

Given the economic size of the related areas, the small touches to be done with the aim of improving recommendation systems will have great effects. The first section of this research includes brief

information about recommendation systems. Current researches in the recommendation systems literature are in the second section. Proposed model and practical application of this proposed model have been given in the rest of this article. The last section of the document includes conclusion and future works.

Related Research

Current researches in CF that study on correctness of overall rating that is given by user. To automatically calibrate and modify given ratings sentiment analysis and opinion mining on comments are used (Wang, Lu & Zhai, 2010). Besides these techniques new approaches and methods are used like deep learning instead of machine learning. To calibrate user rating and to calculate weighted rates, ABSA (Aspect Based Sentiment Model) is the most successful method that comes from opinion mining field. ABSA also includes Deep Learning and Sentiment Analysis techniques (Wang & Liu, 2015). ABSA includes LARA (Latent Aspect Rating Analysis) and Deep Learning Techniques for differentiate given review into categorized and rated sentences. Deep learning framework to extract aspects and the associated sentiments is designed in ABSA (Wang & Liu, 2015). Figure 1 shows the overall architecture of the system.

The system is decomposed into two parts: an aspect model and a sentiment model. The aspect model takes in a sentence vector (or a set of word vectors) and outputs a probabilistic distribution over the aspects (E#A pairs). In (E#A pairs) E stands for entity and A stands for attribute that are shown in table 1. The sentiment model takes in a sentence and outputs the sentiment of the sentence. The sentiment is connected to target aspects by augmenting the word vectors with aspect-specific re-scaling (Wang & Liu, 2015).

Classical ML (Machine Learning) and DM (Data Mining) approaches showed several limitations in terms of understanding human language (Berry & Castellanos, 2007). The proposed ML, DM and TM (Text Mining) problems that come from literature will be tried to solve with new approach DL (Deep Learning). It has been used by different online social networks applications such as sentiment analysis of short texts (Severyn & Moschitti, 2015), recommender systems (Wang & Liu, 2015), and predicting the popularity (Tang, Qin & Liu, 2015).

The main contribute in the text analytics domain is that it can remove the language dependency. Deep learning techniques can be used in opinion mining to improve aspect segmentation, sentence classification and sentiment analysis on user reviews. Summarizing a given text, detecting similarities between sentences, answering to a question or analyzing a comment needs to build a representative model of the text which can take into consideration all possible dimensions (temporality, semantics, language, structure, etc.) (Amir, Tanasescu & Zighed, 2016).

Deep learning is a promising alternative to traditional methods, as it has shown excellent performance in NLP tasks, including Sentiment Analysis (Collobert et al, 2011). Sentiment analysis consists in finding automatically the polarity (positive, negative or neutral) of a natural language sentence or a document. This task is at hand when there is a need to determine the opinion conveyed by the texts produced by an individual or a community: detecting hostile messages and flame wars, classifying movie reviews and thereby trying to predict movie success, opinions about products including predicting sales, assessing citizens' satisfaction of public policies and predicting election results from Twitter. Sentiment Analysis (SA) is an increasingly growing task (Chen & Liu, 2015), whose goal is the classification of opinions and sentiments expressed in text, generated by a human party.

As a result, our research will include sentiment analysis topics of Deep Learning to do opinion mining on user reviews. In text analytics Deep Learning gives proper results without language dependency.

Proposed Model

We will use a model that is proposed based on ABSA as a reference by us, to improve and calibrate user ratings in Collaborative Filtering Recommender Systems on Turkish language. Figure 2 shows the architecture of proposed model to analyze user reviews in Turkish language.

The user reviews in a specific domain are more consistent and according to proposed model it is necessary to create a class tree of a specific domain, so a domain must be defined at the beginning of the applying proposed model. Sufficient amount of user review is required in the relevant working domain. To take these reviews several sources can be used such as e-commerce companies. The next step of the model is that each review should be splitted into sentences. A domain specific class tree that should be included class/subclass names and their related sentences, should be created from extracted sentences the proposed model has two different sub models that are Classifier Model and Smart Sentiment Model. To train these models domain specific class tree is needed. Our existing sub-models that are called Classifier and Smart Sentiment models, have a complex structure that can use all of the classification algorithms such as Naive Bayes, Support Vector Machine, Random Forest, 1-

NN etc. and at the same time is housed in Word2Vec from deep learning algorithms. The models are located on a server in the cloud environment and can be queried via web service after being trained with the class tree created for the respective domain. We are not able to give more technical details here as it is still being developed and because it is a commercial value. The detailed technical information of the relevant models will be given in future studies. The next part of the work includes the practical application of the model.

Application of Proposed Model

The first action of the proposed model is defining working domain. In our research the android smart phones domain has been selected as a working domain for applying proposed model. Approximately

26000 user reviews in Turkish language that are related to our defined domain, have been crawled and downloaded from the e-commerce web sites. TF-IDF algorithm that comes from data mining literature has been applied to all user reviews to eliminate worthless user reviews. Before the application of the algorithm all stop words have been removed from user reviews. Stop word list has been taken from Zemberek library stop word list in Turkish. TF-IDF algorithm outputs a score for each user review between 0 and 1. The user reviews that has smaller score than 0.4, have been excluded from this research. According to opinion mining on user reviews, the remaining reviews should be splitted into sentences to calculate weighted rate. To split each review into sentences, we cannot use standard NLP algorithms due to the inadequacy of them in Turkish language. Zemberek NLP library can split a given text that is in Turkish into sentences according to punctuations. This is not enough for us due to 90 percent of user reviews did not include any punctuation. We have created a list that includes frequently used adjectives in user reviews. A program has been written to split user reviews into sentences according to adjective list. The program also uses Zemberek library to define verbs of a given Turkish text. As an example, when we run the program on the following user review, the outputs have been produced that shown in table 2. While bold words indicate adjectives, reds indicate verbs.

“Telefon **guzel** kamera **orta seviyede** şarj suresi 1 gün **rahat gidiyor** **şık** bir dizaynı var en önemli özelliği güncellemelerini bu telefona **ilk önce gelmesi** ve android 6 **olması** bu sürümde uygulamaları indirirken uygulama izinleri kullanıcının iznine **sunulmuş** **sade** bir telefon sadece Google uygulamaları var 4g olması da çok **guzel** çünkü bu fiyata 4 g destekleyen bir telefon bulmak **zor**.”

The produced sentences are one of the inputs of classifier model. Before the running of classifier model, we should train classifier model with domain specific class tree that has been needed to manually creation according to defined working domain. Following class tree has been created from the user reviews. Each class and subclass of class tree includes at least 100 sentences that are related to their class.

Classifier model has been trained with this class tree and sentences that are in all classes. After this training process, the classifier model has taken new Turkish sentences that are extracted from user reviews, and outputs aspect of each sentence. When we give above example as sentences that is not included in trained set, we have got the results that are shown in Table2 for each sentence.

Some sentences can have more than one aspect. Our model produces all possible aspects with their probabilities. The probabilities of aspects can give some ideas about which class should be assigned to related sentence. The probabilities of aspects for given sentences are also appeared in table 2.

Conclusion

The purpose of these studies is to contribute to the development of more accurate and effective recommendation systems in the field of e-commerce by making various analyzes in Turkish language. Opinion mining that includes text analytics on user reviews, is the key topic for development of recommendation systems. A model has been proposed for applying opinion mining techniques on user reviews in Turkish language. When the model is applied, the emerging results can be considered successful.

Future Work

The application of the Smart Sentiment model is outside the scope of this work. We will have the polarity of each sentence after the smart sentiment model is applied to the obtained sentences. In this way, we will complete the steps of the model we propose, and we will have valuable outputs to calculate the weighted rate, to create aspect based collaborative filtering, to calibrate given rate and to bring a user profile to a different domain to make recommendations. For the development of the sub models that are Classifier and Smart Sentiment Model, we will try to train them with more sentences. The program that extracts the sentences from user reviews in Turkish sentences will be continuing to develop in order to obtain more accurate sentences.

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Addendum

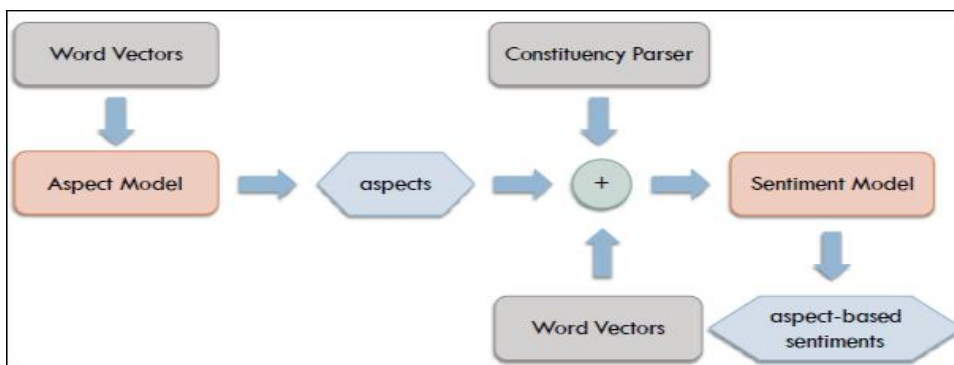


Figure 1. ABSA Architecture depicted from (Wang & Liu, 2015)

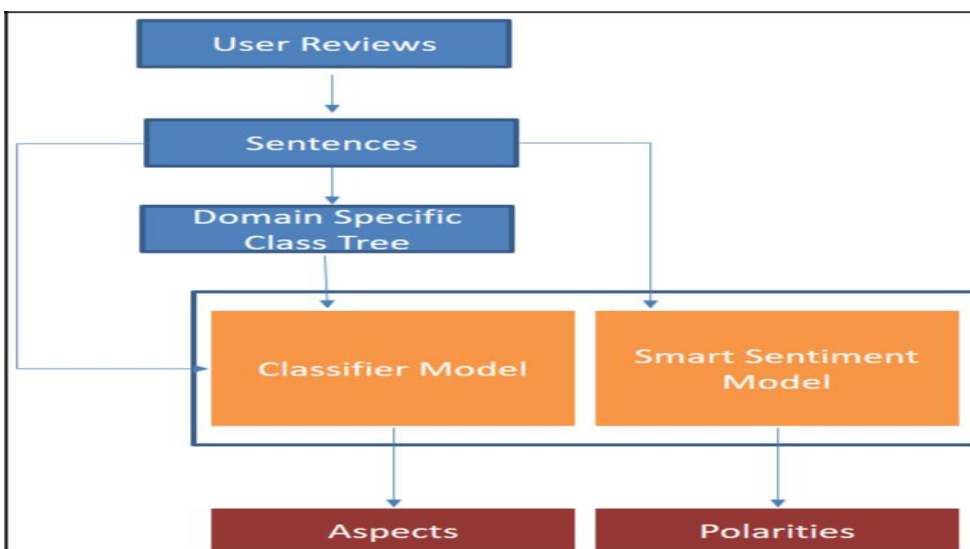


Figure 2. Proposed model to analyze user reviews in Turkish Language.

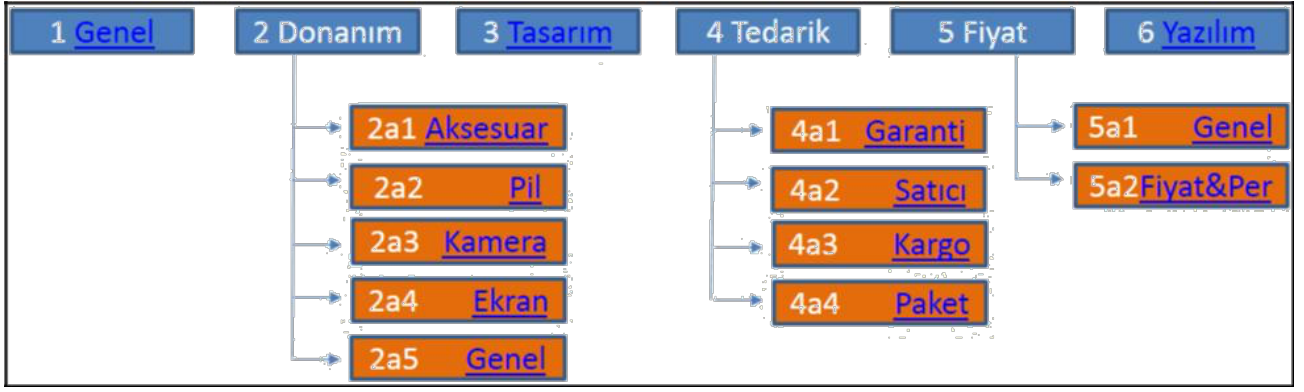


Figure 3. Domain specific class tree in android smart phone domain.

Table 1

Example data snippet for ABSA

<pre> <sentence id="B00KMRGF28_381_AH6TXTDWVUNLS:0> <text> Lovely location. However, for 820 euros this was really bad value </text> <Opinions> <Opinion category="HOTEL#PRICE" polarity="negative"/> <Opinion category="LOCATION#LOCATION" polarity="positive"/> </Opinions> </sentence> </pre>
--

Table 2

Sentences of a given review and their aspects

Sentence	Aspect ID&Prob	Sentence	Aspect ID&Prob
Telefon guzel	3 (0.53) 1 (0.40)	kamera orta seviyede	2a3 (1.00)
şarj suresi 1 gün rahat gidiyor	2a2 (1.00)	şık bir dizaynı var en önemli özelliği güncellemelerini bu telefona ilk önce gelmesi.	3 (0.70) 6 (0.30)
ve android 6 olması	6 (1.00)	bu sürümde uygulamaları indirirken uygulama izinleri kullanıcının iznine sunulmuş	6 (1.00)
sade bir telefon sadece Google uygulamaları var 4g olması da çok guzel	1 (0.50) 6 (0.40)	çünkü bu fiyata 4 g destekleyen bir telefon bulmak zor	5a2 (1.00)