

SentIta and Doxa: Italian Databases and Tools for Sentiment Analysis Purposes

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Abstract

English. This reserach presents SentIta, a Sentiment lexicon for the Italian language, and Doxa, a prototype that, interacting with the lexical database, applies a set of linguistic rules for the Document-level Opinionated teXt Analysis. Details about the dictionary population, the semantic analysis of texts written in natural language and the evaluation of the tools will be provided in the paper.

Italiano. *Questa ricerca presenta SentIta, un lessico dei Sentimenti per l'Italiano, e Doxa, un prototipo che, interagendo con il lessico, applica una serie di regole linguistiche per l'analisi di testi contenenti opinioni. Dettagli in merito al popolamento del dizionario, all'analisi semantica di testi scritti in linguaggio naturale e alla valutazione degli strumenti utilizzati saranno forniti nell'articolo.*

1 Introduction

Through online customer review systems, Internet forums, discussion groups and blogs, consumers are allowed to share positive or negative information than can influence in different ways the purchase decisions and model the buyer expectations, above all with regard to experience goods (Nakayama et al., 2010); such as hotels (Ye et al., 2011), restaurants (Zhang et al., 2010), movies (Duan et al., 2008), books (Chevalier and Mayzlin, 2006) or videogames (Zhu and Zhang, 2006).

The consumers, as Internet users, can freely share their thoughts with huge and geographically dispersed groups of people, competing, this way, with the traditional power of marketing and advertising channels.

Differently from the traditional word-of-mouth,

which is usually limited to private conversations, the user generated contents on Internet can be directly observed and described by the researchers.

The present paper will provide in Section 2 a concise overview on the most popular techniques for both sentiment analysis and polarity lexicon propagation. Afterward, it will describe in Section 3 the method used to semi-automatically populate SentIta, our Italian sentiment lexicon and in Section 4 the rules exploited to put the words' polarity in context. In the end, Sections 5 will describe our opinion analyzer Doxa, that performs document-level sentiment analysis, sentiment role labeling and feature-based opinion summarization.

2 State of the Art

The most used approaches in sentiment analysis include, among others, the lexicon-based methods, which are grounded on the idea that the text semantic orientation can be inferred by the orientation of words and phrases it contains.

In literature, polarity indicators are usually adjectives or adjective phrases (Hatzivassiloglou and McKeown, 1997; Hu and Liu, 2004; Taboada et al., 2006); but recently also the use of adverbs (Benamara et al., 2007), nouns (Vermeij, 2005; Riloff et al., 2003) and verbs (Neviarouskaya et al., 2009) became really common.

Among the most popular lexicons for the sentiment analysis, WordNet-Affect (Strapparava et al., 2004), SentiWordNet (Esuli and Sebastiani, 2006) and SentiFul (Neviarouskaya et al., 2011) deserve to be cited. Because the largest part of the state of the art lexicons focuses on the English language, Italian lexical databases are mostly created by translating and adapting the English ones (Steinberger et al., 2012; Baldoni et al., 2012; Basile and Nissim, 2013; Hernandez-Farias et al., 2014).

As regards the works on lexicon propagation, we mention thesauri-based works (Kim and Hovy,

2004; Esuli and Sebastiani, 2006; Hassan and Radev, 2010; Maks and Vossen, 2011), corpus-based approaches (Turney, 2002; Baroni and Vagnaduzzo, 2004; Qiu et al., 2009; Wawer, 2012) and morphological strategies (Moilanen and Pulman, 2008; Ku et al., 2009; Neviarouskaya, 2010; Wang et al., 2011).

Due to the strong impact of the syntactic structures in which the lemmas occur on the resulting polarity of the sentences, we can find in literature many studies on contextual polarity shifters, e.g. Choi and Cardie (2008), Benamara et al. (Benamara et al., 2012) on negation; Kennedy and Inkpen (2006) and Polanyi and Zaenen (2006) on intensification; Taboada et al. (2011) and Narayanan et al. (2009) on irrealis markers and conditional tenses.

3 Prior Polarity: Building and Propagating Italian Lexical Resources

In this work we created SentIta, a Sentiment lexicon for the Italian language, that has been semi-automatically generated on the base of the richness of the Italian lexical databases of Nooj¹ (Silberstein, 2003; Vietri, 2014) and the Italian Lexicon-grammar (LG) resources² (Elia et al., 1981; Elia, 1984).

The tagset used for the Prior Polarity annotation (Osgood, 1952) of the lexical resources is composed of four tags (POS *positive*; NEG *negative*; FORTE *intense* and DEB *weak*), that combined together generate an evaluation scale that goes from -3 (+NEG+FORTE) to +3 (+POS+FORTE) and a strength scale that ranges from -1 (+DEB) to +1 (+FORTE). Neutral words have been excluded from the lexicon.

Details about the lexical asset available for the Italian language is summarized in Table 1.

Because hand-built lexicons are definitely more accurate than the automatically-built ones, especially in cross-domain sentiment analysis tasks (Taboada et al., 2011; Bloom, 2011), we started the creation of the SentIta database with the manual tagging of part of the lemmas contained in the Nooj Italian dictionaries. The adjectives and the bad words have been manually extracted and evaluated starting from the Nooj databases, preserving

¹The Nooj software and the Italian module of Nooj are available for download at www.nooj-association.org.

²LG tables available for consultation at dsc.unisa.it/composti/tavole/combo/tavole.asp.

Category	Entries	Example
Adjectives	5.383	<i>allegro</i>
Adverbs	3.626	<i>tristemente</i>
Compound Adv	793	<i>a gonfie vele</i>
Idioms	552	<i>essere in difetto</i>
Nouns	3.122	<i>eccellenza</i>
Psych Verbs	635	<i>amare</i>
LG Verbs	879	<i>prendersla</i>
Bad words	189	<i>leccaculo</i>
Tot	15.179	-

Table 1: Composition of SentIta

their inflectional (FLX) and derivational (DRV) properties.

Compound adverbs³ (Elia, 1990), idioms⁴ (Vietri, 1990; Vietri, 2011), psych verbs⁵ and other LG verbs⁶ (Elia et al., 1981; Elia, 1984) have been manually weighted starting from the Italian LG tables, in order to maintain the syntactic, semantic and transformational properties connected to each one of them.

However, to manually draw up a complete dictionary is a strong time-consuming activity, therefore we automatically derived the remaining parts of the lexicon exploiting a set of morphological rules.

To be more precise, the Prior Polarity has been assigned to adverbs ending in *-mente*, “-ly” (Ricca, 2004) on the base of the morpho-phonological relations with their known adjectival bases (e.g. *allegro* and *allegramente*), with 0.99 Precision and 0.88 Recall. In a similar way, with a Precision of 0.93 and a Recall of 0.72, we made a set of quality nouns inherit the semantic tags of the qualifier adjectives with which they were related (e.g. *eccellente* and *eccellenza*) using a set of 21 suffixes for the noun formation from qualifier adjectives⁷. In

³LG classes of compound adverbs: PC, PDETC, PAC, PCA, PCDC, PCPC, PCONG, CAC, CPC, PV, PF, PCPN, PEW. This list comprises 70 discourse operators, able to summarize (e.g. *in parole povere*), invert (e.g. *nonostante ciò*), confirm (e.g. *in altri termini*), compare (e.g. *allo stesso modo*) and negate (e.g. *neanche per sogno*) the opinion expressed in the previous sentences of the text.

⁴LG classes of frozen sentences with *essere* as support verb: CEAC, EAA, EAPC, ECA, PECO.

⁵LG classes of psych verb: 41, 42, 43, 43B.

⁶Other LG classes of verbs: 2, 2A, 4, 9, 10, 11, 18, 20I, 20NR, 20UM, 21, 21A, 22, 23R, 24, 27, 28ST, 44, 44B, 45, 45B, 47, 47B, 49, 50, 51, 53, 56.

⁷The suffixes for the quality noun formation (Rainer, 2004) are *-edine*, *-edine*, *-età*, *-izie*, *-ela*, *-udine*, *-ore*, *-(z)ione*, *-anza*, *-itudine*, *-ura*, *-mento*, *-izia*, *-enza*, *-eria*, *-ietà*,

the end, we also collected a list of 37 prefixes (Iacobini, 2004), that, as morphological Contextual Valence Shifters (CVS), are able to negate (e.g. *anti-*, *contra-*, *non-*, ect) or to intensify/downtone (e.g. *arci-*, *semi-*, ect) the orientation of the words in which they appear. They directly work on opinionated documents, in order to make the machine understand the actual orientation of the words occurring in real texts, also when their morphological context shifts the polarity of the words listed in the dictionaries.

4 Contextual Polarity: Rules for the Sentence-level Sentiment Analysis

Grounding a sentiment analysis tool only on the simple lexical valence of negative or positive words can become misleading in all the cases in which the sentence or the discourse context shifts the valence of individual terms.

In order to annotate real texts with the proper semantic orientation, we took advantage of the finite-state technology, thanks to which we could systematically recall and modify the prior polarities expressed in the dictionaries on the base of the syntactic contexts in which the words occur.

Among the most used CVS, we took into account linguistic phenomena like Intensification, Negation, Modality and Comparison.

In this work the sentence annotations is not performed through mathematical computations; instead, it is grounded on the semantic labels attributed to each one of the embedded nodes of the finite-state automata (FSA), which contain, just as boxes, all the syntactic structures that should obtain the same score. This choice is due to the fact that the effects of the interactions between word polarities and CVS on the semantics of phrases and sentences are various, but regular. As an example, negation⁸ does not always switch the polarity of the modified words: as it can be observed in

-aggine, *-ia*, *-ità*, *-ezza*, *-igia*, *-(z)a*. They generally make the new words simply inherit the orientation of the derived adjectives. Exceptions are *-edine* and *-eria* that almost always shift the polarity of the quality nouns into the weakly negative one (-1), e.g. *faciloneria* “slapdash attitude”. Also the suffix *-mento* differs from the others, in so far it belongs to the derivational phenomenon of the deverbal nouns of action (Gaeta, 2004). It has been possible to use it in this work noun derivation by using the past participles of the verbs listed in the adjective dictionary of sentiment.

⁸As negation indicators we took into account negative operators (e.g. *non*, “not”, *mica*), negative quantifiers (e.g. *nessuno*, “nobody” *niente*, *nulla*, “nothing”) and lexical negation (e.g. *senza*, “without”, *mancanza di*, *assenza di*, *carezza di*, “lack of”) (Benamara et al., 2012).

Table 2, there are cases in which it is only shifted.

Regarding intensification, we considered the cases in which intensifiers and downtoners modify the opinionated words; superlative, and repetition of positive or negative words. Basically, adjectives can only modify the intensity of nouns, while adverbs intensify or attenuate adjectives, verbs and other adverbs.

Because intensification and negation can also appear together in the same sentence, we took into account this eventuality by weighting firstly the intensification and then the negation.

Rules	Example	Score
Adj ⁺²	<i>bello</i>	+2
Adj ⁺² +Adj ⁺²	<i>bello, bello</i>	+3
Adj ⁺² +Adv ⁺	<i>molto bello</i>	+3
Adj ⁺² +Sup	<i>bellissimo</i>	+3
Adj ⁺² +Adv ⁻	<i>poco bello</i>	-2
Adj ⁺² +Neg	<i>non bello</i>	-2
Adj ⁺² +Neg + Adv ⁺	<i>non molto bello</i>	-1
Adj ⁺² +Neg+Sup	<i>non bellissimo</i>	-1
Adj ⁺² +Neg+Adv ⁻	<i>non poco bello</i>	+1

Table 2: An example of intensification and negation rules on a positive adjective

As concerns modality (Benamara et al., 2012), we contemplated modal verbs (e.g. *dovere*, *potere*), conditional tenses (Narayanan et al., 2009) and doubt or necessity adverbs (e.g. *più o meno*, *di sicuro*).

In order to detect similarities and differences between two or more objects, we listed a set of comparative opinion indicators; namely, comparative frozen sentences of the type *NO Agg come CI* (Vietri, 1990); some simple comparative sentences that involve the expressions *meglio di*, *inferiore a*; and the comparative superlative (e.g. *il più*, *il peggiore*).

5 Doxa: a Document-level Opinionated teXt Analyzer

Using the command-line program *noojapply.exe*, we built a Java prototype by which users can automatically apply the resources formalized in *Nooj* to every kind of text.

Doxa, in its standard version, is a Document-level Opinionated teXt Analyzer that evaluates customer reviews, by summing up the values corresponding to every sentiment expression and, then, normalizes the result for the total number of

sentiment expressions contained in the text. In the end, it compares the resulting values with the stars that the opinion holders gave to their reviews and provides statistics about the opinions expressed in each case (Maisto and Pelosi, 2014a).

The test dataset used to evaluate the performances of Doxa contains Italian opinionated texts in the form of users reviews and comments from e-commerce and opinion websites. It lists 600 texts units (300 positive and 300 negative for each product class) and refers to experience and search goods, for all of which different websites have been exploited⁹.

In the sentence-level sentiment analysis Doxa achieved an average Precision of 0.75 and a Recall of 0.73, and in the document-level classification an average Precision of 0.74 and a Recall of 0.97.

Although the document-level analysis provides important information regarding the consumers needs and expectations, for companies it is crucial to discern the aspects of the products that must be improved, or whether the opinions extracted online by the sentiment analysis applications are relevant to the products or not. That is why we designed new sentiment analysis modules for Doxa: a sentiment role labeling module (Pelosi et al., 2015 in press) and a feature-based sentiment analyzer (Maisto and Pelosi, 2014b).

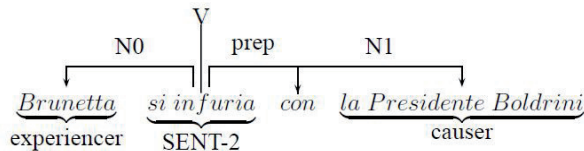


Figure 1: Sentiment Role Labeling

In the first task the achieved F-score was 0.71 in a Twitter dataset and 0.76 in a free web news headings dataset provided by DataMediaHub. As shown in Figure 1, the tool is based on the matching between the definitional syntactic structures, attributed to the each one of the 28 LG class of Italian verbs, and the semantic information attached in the sentiment database to every lexical

⁹Books: www.amazon.it, www.qlibri.it,
Movies: www.mymovies.it, www.cinemalia.it,
www.filmstv.it, www.filmscoop.it, Hotels: www.tripadvisor.it, www.expedia.it,
www.venere.com, it.hotels.com, www.booking.com and Videogames: www.amazon.it, Cars: www.ciao.it,
Smartphones: www.tecnoscoop.it, www.ciao.it, www.amazon.it, www.alatest.it.

entry. The semantic roles evoked by this selection of verbs pertain to three frames: *Sentiment* (*experiencer, causer*), *Opinion* (*holder, target*) and *Physical act* (*agent, patient*).



Figure 2: Feature-based module of Doxa

In the feature based sentiment analysis (Maisto and Pelosi, 2014b), which allows the comparison between more than one object on the base of different kind of aspects that characterize them (Figure 2), we achieved 0.81 F-score on a corpus of hotels reviews.

Because sometimes a lexicon is not enough to correctly extract and classify the product features, domain-specific FSA have been formalized in order to make the analyses adequate to the corpus (e.g. *L'hotel vicinissimo alla metro.*, BENEFIT TYPE="LOCATION" SCORE="3").

6 Conclusion

In the present paper we underlined that the social and economic impact of the online customer opinions and the huge volume of raw data available on the web, concerning users point of views, offer new opportunities both to marketers and researchers.

Indeed, sentiment analysis applications, able to go deep in the semantics of sentences and texts, can play a crucial role in tasks like web reputation monitoring, in social network analysis, in viral tracking campaigns, etc...

Therefore, we presented SentIta, a semi-automatic Italian Lexicon for Sentiment Analysis, and Doxa, a Document-level Opinionated teXt Analyzer that exploits finite-state technologies to go through the subjective dimension of user generated contents.

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